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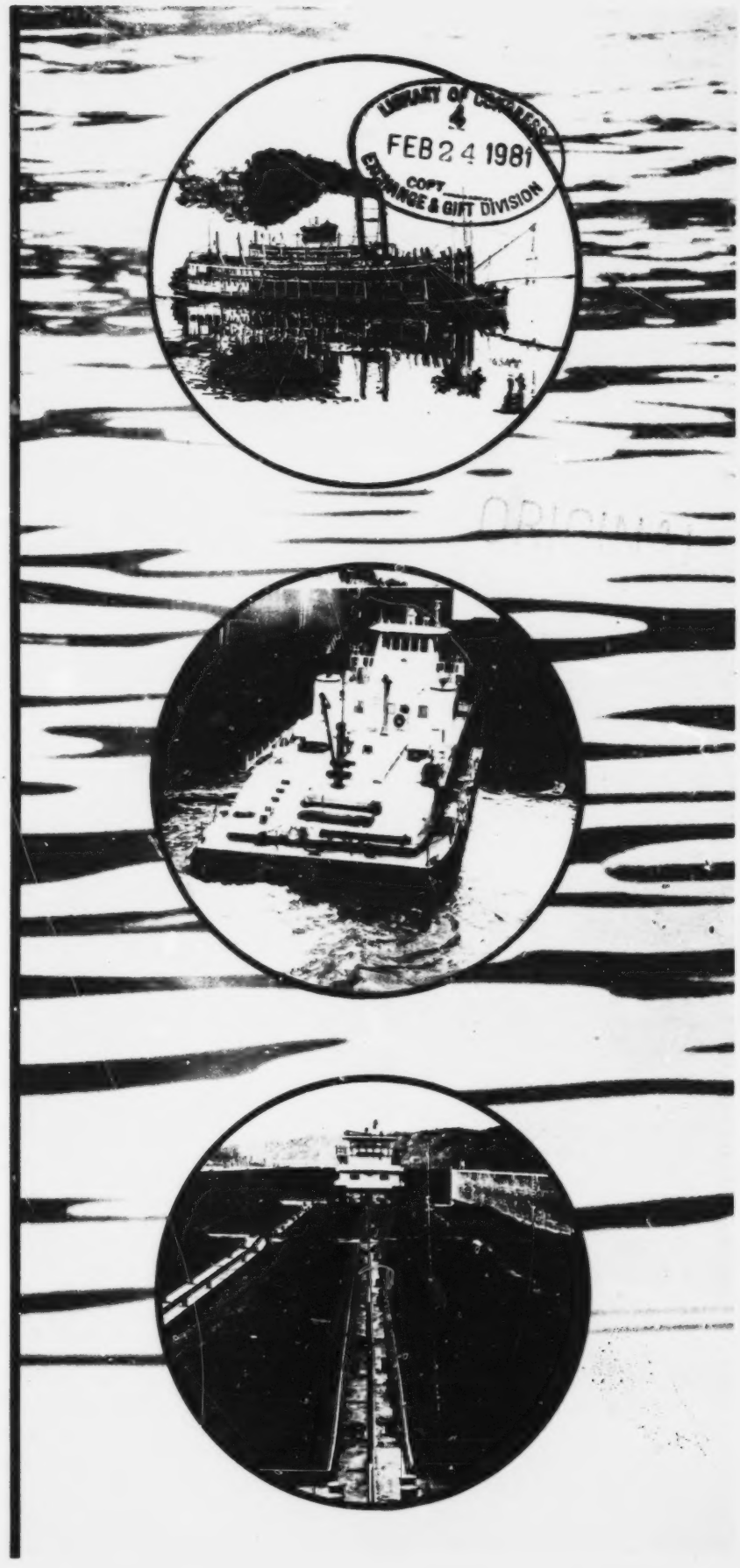
Projections Of Demand For Waterborne Transportation

Ohio River Basin
1980 - 2040

Volume 10

Iron Ore, Steel and Iron



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Inland waterways	Traffic surveys	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System. Each of the studies considers existing waterborne commerce and develops a consistent set of projects of future traffic demands for all of the navigable waterways of the Basin. Each report contains information on past and present waterborne commerce in the Basin and projections by commodity groups and origin-destination areas from 1976 to at least 1990.

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(Continued from #20)
The three study projections, in conjunction with other analytical tools and system information, will be used to evaluate specific waterway improvements to meet short and long-term navigation needs. The output from these studies will serve as input to Corps' Inland Navigation Simulation Models to help analyze the performance and opportunities for improvement of the Ohio River Basin Navigation System. These data will be used in current studies relating to improvement of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, the Cumberland River and the Tennessee River, as well as other improvements.

This document is volume 10 of the 17 volume report shown below.

The study included a Commodity Resource Inventory, a Modal Split Analysis and a Market Demand Analysis. The work included investigation and analyses of the production, transportation and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of and within the Ohio River Basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A study summary aggregates the commodity group totals for each of the several projections periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin. The study results are presented in the following 17 documents:

Volume	Subject Title	
1	Study summary	
2	Methodology	
3	Group I:	Coal and coke
4	Group II:	Petroleum fuels
5	Group III:	Crude Petrol.
6	Group IV:	Aggregates
7	Group V:	Grains
8	Group VI:	Chemicals and chemical fertilizers
9	Group VII:	Ores and Minerals
10	Group VIII:	Iron ore, steel and iron
11	Group IX:	Feed and food products, nec.
12	Group X:	Wood and paper products
13	Group XI:	Petroleum products, nec.
14	Group XII:	Rubber, plastics, nonmetallic, mineral, products, nec.
15	Group XIII:	Nonferrous, metals and alloys, nec.
16	Group XIV:	Manufactured products, nec.
17	Group XV:	Other, nec.

Additionally, an Executive Summary is available as a separate document.

Volume 10 of 17

GROUP VIII: IRON ORE, STEEL AND IRON

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION OHIO RIVER BASIN 1980, 1990, 2000, 2020, 2040

Prepared for

U.S. ARMY CORPS OF ENGINEERS
OHIO RIVER DIVISION, HUNTINGTON DISTRICT

Contract No. DACW69-78-C-0136

by

Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

DECEMBER 1980

III

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"...one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System."

CONTENTS: v.1. Study summary.--v.2. Methodology.--v.3. Commodity groups .

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PREFACE

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River basin navigation system. Each of the studies considers existing waterborne commerce and develops a consistent set of projections of future traffic demands for all of the navigable waterways of the basin. Each report contains information on past and present waterborne commerce in the basin with projections by commodity group and origin-destination areas from 1976 to either 1990 or 2040.

The three projections, in conjunction with other analytical tools and waterway system information, will be used to evaluate specific waterway improvements required to meet short and long-term navigation needs. The output from these studies will serve as input to Corps inland navigation simulation models to help analyze the performance and requirements for improvements of the Ohio River basin navigation system. These data will be used in current studies relating to improvements of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, and the Tennessee River, as well as for other improvements.

The reports on the three studies are referred to as the "CONSAD," the "BATTELLE," and the "NATHAN" reports. The latter and final report was completed in November 1980. It was prepared for the Corps of Engineers by Robert R. Nathan Associates, Inc., Consulting Economists, Washington D.C. This study encompasses the period 1976-2040, and is by far the most detailed of the three.

The "CONSAD" report, completed in January 1979, was prepared for the Corps by the CONSAD Research Corporation of Pittsburgh, Pennsylvania. The study and the 1976-1990 projected traffic demands discussed in that report were developed by correlating the historic waterborne commodity flows on the Ohio River navigation system, with various indicators of regional and national demands for the commodities. The demand variables which appeared to best describe the historic traffic pattern for each of the commodity groups was selected for projection purposes. The projected values for the demand variables are based upon the 1972 OBERS Series E Projections of National and Regional Economic Activity. The OBERS projections serve as national standards and were developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, in conjunction with the Economic Research Service of the Department of Agriculture.

The "BATTELLE" report was completed in June 1979, and was prepared for the Corps by the Battelle Columbus Laboratories, Columbus, Ohio. The study and the 1976-1990 traffic projections discussed in that report were developed by surveying all waterway users in the Ohio River Basin through a combined mail survey and personal interview approach. The purpose of the survey was to obtain an estimate from each individual shipper of his future commodity

movements, by specific origins and destinations, as well as other associated traffic information. All identifiable waterway users were contacted and requested to provide the survey information. In addition, personal interviews were held with the major shippers. The responses were then aggregated to yield projected traffic demands for the Ohio River navigation system.

The "NATHAN" report presents the findings of a commodity resource inventory, a modal split analysis and a market demand analysis. The work included investigation and analyses of the production, transportation, and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of, and within the Ohio River basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A Study Summary and an Executive Summary present appropriately abbreviated discussion and findings resulting from these analyses. The Study Summary aggregates the commodity group totals for each of the several projection periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin.

The "NATHAN" report, "Projections of Demand for Waterborne Transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040" consists of the following volumes:

Subject Title	Number of Pages	Volume Number
Study Summary	220	1
Methodology	118	2
Group I: Coal and Coke	134	3
Group II: Petroleum Fuels	66	4
Group III: Crude Petroleum	42	5
Group IV: Aggregates	64	6
Group V: Grains	131	7
Group VI: Chemicals and Chemical Fertilizers	90	8
Group VII: Ores and Minerals	61	9
Group VIII: Iron Ore, Steel and Iron	104	10
Group IX: Feed and Food Products, Nec.	44	11
Group X: Wood and Paper Products	61	12
Group XI: Petroleum Products, Nec.	38	13
Group XII: Rubber, Plastic, Nonmetallic Mineral Products, Nec.	41	14
Group XIII: Nonferrous Metals and Alloys, Nec.	57	15
Group XIV: Manufactured Products Nec.	35	16
Group XV: Others, Nec.	48	17

Additionally, an Executive Summary is available as a separate document.

RRNA

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION OHIO RIVER BASIN 1980, 1990, 2000, 2020, 2040

Group VIII: Iron Ore, Steel and Iron

Prepared for
U.S. Army Corps of Engineers
Huntington District
Contract No. DACW69-78-C-0136

by
Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

November 1980

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I. INTRODUCTION

Group VIII, iron ore, steel and iron, consists of ferrous bearing materials and products associated with the production and shipment of rolled steel mill products and of iron and steel castings. During 1969-76, commodities in this group accounted for an average 2.4 percent of total Ohio River System (ORS) waterway traffic. Although the waterborne tonnage of iron ore, steel and iron in the ORS fluctuates from year to year, more than 5.0 million tons moved on the waterway in 1976.

The areas within the Ohio River Basin (ORB) for which projections of Group VIII consumption, production and movements have been made are designated as Primary Study Areas (PSAs). The PSAs for Group VIII are those U.S. Department of Commerce Bureau of Economic Analysis Areas (BEAs) and area segments (aggregations of counties within a BEA) which are origins or destinations of Group VIII waterborne movements. A map showing Group VIII PSAs is presented in Appendix B.

In addition to the PSAs, external areas linked to the ORB through waterborne commerce were identified. Areas (BEAs) outside the ORB which are destinations of waterborne iron ore, steel and iron movements originating in the ORB are designated as Secondary Consumption Areas (SCAs). Areas (BEAs) outside the ORB which are origins of Group VIII waterborne movements destined to the ORB are designated a Secondary Production Areas (SPAs).

A. Description of Commodity Group VIII

The individual commodities included in the iron ore, steel and iron group, and their corresponding Waterborne Commerce Statistics Codes (WCSC), are as follows:

Waterborne Commerce Statistics Code (WCSC)	Commodity/ Product
1011	Iron ore and concentrates

3311	Pig iron
3314	Iron and steel and other primary forms including blanks for tube and pipe, and sponge iron
3315	Iron and steel bars, rods, angles, shapes, and sections, including sheet piling
3316	Iron and steel plates and sheets
3317	Iron and steel pipe and tube
3318	Ferroalloys
3319	Primary iron and steel products, nec., including castings in rough
4011	Iron and steel scrap.

For purposes of analysis, the individual commodities in Group VIII can be classified into two major categories: (1) raw and secondary materials which are inputs into the iron and steelmaking process; and (2) iron and steel products. The latter category includes intermediate shapes and forms, and rolled and milled steel products. The categories, by WCSC, are as follows:

Raw and secondary input materials (WCSC 1011, 3311, 3318, and 4011);

Intermediate shapes and forms, and rolled and milled steel products (WCSC 3314, 3315, 3316, 3317, and 3319).

Since the raw material inputs possess different production, consumption and transportation characteristics than those of iron and steel products, the above categorizations were used throughout this study to facilitate analysis.

B. Existing Waterway Traffic Flows

The total inbound, outbound and local waterborne movements of iron ore, steel and iron in the ORS fluctuate from year to year. In 1969, total ORS waterway traffic for this commodity group was approximately 4.2 million tons (Table 1). In 1973, a record year for steel production, ORS waterborne traffic of iron ore, steel and iron was more than 5.4 million tons. In 1976, ORS iron and steel waterborne movements totalled 5.1 million tons.

Iron ore, steel and iron shipments accounted for 2.5 percent of all waterborne commerce on the Ohio River System in 1976 (Table 2). Inbound iron ore, steel and iron movements accounted for approximately 2.0 million tons, and outbound movements were slightly more than 1.5 million tons. Local shipments of iron ore, iron and steel accounted for 1.5 million tons. Thus, a high percentage of Group VIII commodities either enter or leave the Ohio River System and, consequently, long haul waterborne movements tend to be the rule.

B-1. BEA-to-BEA Traffic Flows

BEA-to-BEA movements for 1976 in the ORS are presented in Table 3. The Pittsburgh area (BEA 66) was the largest receiver and shipper of iron ore, steel and iron commodities in the ORB. In 1976, BEA 66 received 1,305.7 thousand tons of iron ore, steel and iron via the waterway, or 26 percent of total iron ore, steel and iron receipts in the study area. The Pittsburgh area was also the largest shipper of Group VIII commodities and products. It shipped 2,305.5 thousand tons in 1976 and accounted for 46 percent of all iron ore, steel and iron waterway shipments originating in the study area.

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Table 1 . Ohio River System: Waterborne Shipments of Iron Ore, Steel and Iron by Commodity Inbound, Outbound, and Local Movements, 1969-76

(Thousands of tons unless otherwise specified)

Commodity and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Total	4,167.7	5,198.3	4,478.8	5,396.9	5,403.6	5,142.5	4,161.8	5,063.9	2.8
Inbound	792.1	995.6	990.8	1,390.9	1,457.2	1,562.3	1,322.7	2,044.3	14.5
Outbound	1,330.7	2,296.6	1,559.0	1,862.4	1,771.1	1,811.8	1,549.0	1,501.6	1.7
Local	2,044.9	1,906.1	1,929.0	2,143.6	2,175.4	1,768.4	1,290.1	1,518.0	(4.2)
Iron ore	212.5	409.5	243.7	511.1	516.3	466.5	359.9	748.8	19.7
Inbound	212.5	408.5	243.7	491.8	514.2	463.7	358.5	738.7	19.5
Outbound	--	1.0	--	13.7	--	--	--	10.1	a
Local	--	--	--	5.6	2.1	2.8	1.4	--	--
Pig iron	214.5	47.5	37.7	40.5	45.1	122.0	112.1	71.8	(14.5)
Inbound	--	--	--	--	--	36.5	12.7	25.4	a
Outbund	52.1	14.7	8.9	10.8	5.9	20.6	4.6	8.6	(22.7)
Local	162.4	32.8	28.8	29.7	39.2	64.9	94.8	37.8	(18.8)
Ingots	40.0	422.9	888.0	1,016.8	959.6	396.9	516.5	141.1	19.7
Inbound	5.7	12.6	15.3	6.9	9.9	25.6	42.3	98.9	50.3
Outbound	13.9	392.6	103.5	30.5	48.0	48.2	175.1	28.4	10.8
Local	20.4	17.7	769.2	979.4	901.7	323.1	299.1	13.8	(5.4)
Bars, rods, angles	505.6	643.6	565.5	498.7	497.5	804.7	496.5	554.7	1.3
Inbound	145.5	132.9	188.6	150.5	153.8	244.0	275.5	326.5	12.2
Outbound	231.0	360.9	199.6	215.9	204.3	279.7	113.8	128.6	(8.0)
Local	129.1	149.8	177.3	132.3	139.4	281.0	107.2	99.6	(3.6)
Plates and sheets	744.1	1,096.0	1,171.3	1,332.2	1,358.1	1,651.5	1,174.2	1,394.2	9.4
Inbound	111.8	109.4	251.1	300.8	286.4	310.2	229.9	241.7	11.6
Outbound	306.8	626.7	432.8	603.1	553.1	706.7	491.5	601.1	10.1
Local	325.5	359.9	487.4	428.3	518.6	634.6	452.8	551.4	7.8

(Continued)

Table 1. (Continued)

Commodity and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Pipe and tube	674.5	563.5	781.5	799.2	681.0	530.5	580.2	574.4	(2.3)
Inbound	33.1	61.1	32.7	29.6	43.2	2.1	5.1	41.4	3.3
Outbound	584.5	470.7	702.3	728.1	614.1	504.4	565.2	496.1	(2.3)
Local	56.9	31.7	46.5	41.5	23.7	24.0	9.9	36.9	(6.0)
Ferroalloys	257.1	266.8	303.7	378.7	452.8	432.0	506.0	660.7	14.4
Inbound	166.8	116.5	156.2	225.6	275.2	279.4	322.9	477.8	16.2
Outbound	19.3	58.7	50.9	58.1	76.2	65.2	62.7	67.3	19.5
Local	71.0	91.6	96.6	95.0	101.4	87.4	120.4	115.6	7.2
Primary products, nec.	1,138.0	1,365.2	198.6	419.2	497.9	259.6	100.0	459.3	(12.2)
Inbound	51.7	104.5	14.5	116.7	132.7	13.5	15.6	19.9	(12.8)
Outbound	86.0	285.4	32.3	146.4	187.2	149.3	54.9	15.6	(21.6)
Local	1,000.3	975.3	151.8	156.1	178.0	96.8	29.5	423.8	(11.5)
Scrap	381.4	383.4	288.9	400.3	395.3	478.9	316.5	459.3	2.7
Inbound	65.0	50.2	88.9	68.9	41.9	187.3	60.3	72.7	1.6
Outbound	37.2	85.9	28.6	55.9	82.2	37.7	81.3	146.2	21.6
Local	279.2	247.3	171.4	275.5	271.2	253.9	174.9	240.4	(2.1)

Note: Individual items may not add to totals due to rounding.
a. No movements reported in 1969.
Source: Compiled by RRNA from Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

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Table 2. Ohio River System: Waterborne Shipments of All Commodities and of Iron Ore, Steel and Iron, 1976

(Thousands of tons unless otherwise specified)

	Total	Inbound	Outbound	Local
All commodities	200,770.5	29,439.5	26,854.0	144,477.0
Iron ore, steel and iron	5,063.9	2,044.3	1,501.6	1,518.0
As a percentage of all commodities	2.5	6.9	5.6	1.1

Source: Compiled by RRNA from Waterborne Commerce by Port Equivalents, revised 1976, supplied by U.S. Army Corps of Engineers.

Table 3. Ohio River Basin: Waterborne Commerce by BEA, 1976
Group VIII: Iron Ore, Steel and Iron

(Thousands of tons)

Origin	Total	Destination												
		ORB BEAs	BEA 47	BEA 48	BEA 49	BEA 50	BEA 52	BEA 54	BEA 55	BEA 62	BEA 64	BEA 66	BEA 68	BEA 115
TOTAL	5,063.9	3,562.3	235.1	107.2	318.8	1.1	9.2	347.9	95.8	658.8	50.3	1,305.7	361.4	71.0
ORB BEAs	3,019.6	1,518.0	75.3	42.5	61.7	--	4.0	277.8	73.6	190.6	15.0	704.9	47.1	25.5
BEA 47	64.6	27.2	--	--	--	--	--	--	--	--	2.0	20.2	5.0	--
BEA 48	18.4	11.7	--	--	--	--	--	--	--	--	--	9.6	2.1	--
BEA 49	58.3	17.4	--	--	--	--	--	--	--	--	--	17.4	--	--
BEA 50	16.7	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 52	172.2	82.7	3.0	--	--	--	1.0	--	3.0	11.0	--	44.6	1.0	19.1
BEA 54	86.1	65.3	--	--	--	--	--	--	--	1.1	--	64.2	--	--
BEA 55	57.6	41.0	--	--	--	--	--	--	--	2.2	--	37.7	--	1.1
BEA 62	62.1	55.6	--	--	--	--	--	--	--	--	--	55.6	--	--
BEA 64	55.0	21.2	10.0	--	--	--	2.0	2.1	2.0	--	--	1.1	4.0	--
BEA 66	2305.5	1116.0	52.7	42.5	61.7	--	1.0	274.7	68.6	176.3	13.0	420.2	--	5.3
BEA 68	21.9	6.4	3.2	--	--	--	--	1.0	--	--	--	2.2	--	--
BEA 115	101.2	73.5	6.4	--	--	--	--	--	--	--	--	32.1	35.0	--
Non-ORB BEAs	2,044.3	2,044.3	159.8	64.7	257.1	1.1	5.2	70.1	22.2	468.2	35.3	600.8	314.3	45.5
BEA 38	2.1	2.1	--	--	--	--	1.1	1.0	--	--	--	--	--	--
BEA 46	21.5	21.5	--	--	2.2	--	--	--	--	--	--	11.1	8.2	--
BEA 77	308.5	308.5	135.5	31.2	79.0	--	--	24.1	18.9	3.3	3.3	4.1	--	9.1
BEA 78	31.1	31.1	1.1	--	2.2	--	--	--	--	1.1	--	26.7	--	--
BEA 79	15.6	15.6	5.6	--	--	--	--	--	--	--	--	10.0	--	--
BEA 91	2.1	2.1	--	--	--	--	--	--	--	--	--	2.1	--	--
BEA 111	1.1	1.1	1.1	--	--	--	--	--	--	--	--	--	--	--
BEA 113	4.5	4.5	--	4.5	--	--	--	--	--	--	--	--	--	--
BEA 114	23.3	23.3	2.2	--	4.5	--	--	--	--	--	--	14.5	--	2.1
BEA 115[a]	3.2	3.2	2.1	--	--	--	--	--	--	--	--	--	1.1	--
BEA 117	2.1	2.1	--	--	--	--	--	--	--	--	--	2.1	--	--
BEA 118	2.1	2.1	--	--	--	--	--	--	--	--	--	2.1	--	--
BEA 119	1.1	1.1	--	--	--	--	--	--	--	--	--	1.1	--	--
BEA 134	4.4	4.4	--	--	--	--	--	--	--	--	--	4.4	--	--
BEA 135	5.4	5.4	--	--	--	--	--	--	--	--	--	5.4	--	--
BEA 137	40.5	40.5	--	--	3.3	--	--	--	1.1	26.7	--	4.4	5.0	--
BEA 138	1,566.2	1,566.2	12.2	29.0	165.9	1.1	3.1	45.0	2.2	437.1	27.5	511.8	297.0	34.3
BEA 140	1.0	1.0	--	--	--	--	--	--	--	--	--	1.0	--	--
BEA 141	5.5	5.5	--	--	--	--	1.0	--	--	--	4.5	--	--	--
BEA 144	3.0	3.0	--	--	--	--	--	--	--	--	--	--	3.0	--

(Continued)

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Table 3.(Continued)

Origin	Non-ORB BEAs	Destination BEA 39	BEA 46	BEA 77	BEA 78	BEA 79	BEA 89	BEA 91	BEA 103	BEA 107	BEA 111	BEA 114	BEA 115[a]
TOTAL	1,501.6	1.1	101.8	166.5	39.8	1.0	3.3	48.5	1.0	1.1	10.3	206.6	8.0
ORB BEAs	1,501.6	1.1	101.8	166.5	39.8	1.0	3.3	48.5	1.0	1.1	10.3	206.6	8.0
BEA 47	37.4	--	--	8.8	1.1	--	3.3	13.3	--	--	--	3.3	--
BEA 48	6.7	--	--	1.1	--	--	--	--	--	--	--	--	--
BEA 49	40.9	--	--	3.1	10.2	--	--	--	--	--	--	22.5	--
BEA 50	16.7	--	--	16.7	--	--	--	--	--	--	--	--	--
BEA 52	89.5	--	3.0	13.3	4.1	1.0	--	6.0	1.0	--	6.0	12.1	--
BEA 54	20.8	--	5.0	8.5	--	--	--	--	--	--	--	2.1	--
BEA 55	16.6	--	--	3.3	--	--	--	--	--	--	--	2.2	--
BEA 62	6.5	--	1.1	2.2	--	--	--	--	--	--	--	--	--
BEA 64	33.8	--	--	24.4	--	--	--	1.1	--	--	--	7.3	--
BEA 66	1,189.5	1.1	90.5	68.9	21.1	--	--	28.1	--	1.1	4.3	156.0	8.0
BEA 68	15.5	--	2.2	2.2	2.2	--	--	--	--	--	--	--	--
BEA 115	27.7	--	--	14.0	1.1	--	--	--	--	--	--	1.1	--
Non-ORB BEAs													
BEA 38													
BEA 46													
BEA 77													
BEA 78													
BEA 79													
BEA 91													
BEA 111													
BEA 113													
BEA 114													
BEA 115[a]													
BEA 117													
BEA 118													
BEA 119													
BEA 134													
BEA 135													
BEA 137													
BEA 138													
BEA 140													
BEA 141													
BEA 144													

Traffic external to Ohio River System

(Continued)

BEST DOCUMENT AVAILABLE

Table 3. (Continued)

	Destination										
	BEA 117	BEA 118	BEA 119	BEA 133	BEA 134	BEA 135	BEA 137	BEA 138	BEA 140	BEA 141	BEA 144
TOTAL	7.6	49.8	34.2	1.1	3.2	18.1	5.2	372.9	17.1	391.6	11.8
ORB BEAs	7.6	49.8	34.2	1.1	3.2	18.1	5.2	372.9	17.1	391.6	11.8
BEA 47	4.4	--	--	--	--	--	1.1	--	--	1.0	1.1
BEA 48	--	--	--	--	--	--	--	--	--	--	5.6
BEA 49	--	--	--	--	--	--	--	1.1	--	--	4.0
BEA 50	--	--	--	--	--	--	--	--	--	--	--
BEA 52	1.0	5.0	--	--	--	10.0	--	6.0	--	21.0	--
BEA 54	--	--	--	--	--	--	2.1	--	--	3.1	--
BEA 55	--	--	--	--	--	--	--	6.7	--	3.3	1.1
BEA 62	--	--	--	--	--	--	--	--	--	3.2	--
BEA 64	--	--	--	--	--	--	--	1.0	--	--	--
BEA 66	2.2	44.8	34.2	1.1	3.2	8.1	2.0	348.8	17.1	348.9	--
BEA 68	--	--	--	--	--	--	--	--	--	8.9	--
BEA 115	--	--	--	--	--	--	--	9.3	--	2.2	--
Non-ORB BEAs											
BEA 38											
BEA 46											
BEA 77											
BEA 78											
BEA 79											
BEA 91											
BEA 111											
BEA 113											
BEA 114											
BEA 115[a]											
BEA 117											
BEA 118											
BEA 119											
BEA 134											
BEA 135											
BEA 137											
BEA 138											
BEA 140											
BEA 141											
BEA 144											

Traffic external to Ohio River System

a. Consists of counties external to Ohio River Basin.
Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

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B-2. Highlights of Important Links

Of the nine commodities that comprise Group VIII, plates and sheets (WCSC 3316) and iron ore (WCSC 1011) accounted for nearly half of the Group VIII waterborne tonnage in the ORS in 1976. Other commodities and products of the group which were transported by water included ferroalloys (WCSC 3318), 13 percent; bars rods, angles (WCSC 3314), 11 percent; pipe and tube (WCSC 3317), 11 percent; iron and steel scrap (WCSC 4011), 9 percent; and primary products, nec., (WCSC 3319), 9 percent.

The consumption and production characteristics of each commodity or product determine whether the waterborne movements of the commodity or product will be inbound, outbound or local. In general, waterborne shipments of the raw material and secondary inputs are inbound to the ORB, whereas rolled and milled steel products movements tend to be local or outbound movements.

a. Local Movements

Local waterborne movements of iron ore, steel and iron in the ORS amounted to 1,518.0 thousand tons in 1976. In 1976, 551.4 thousand tons of plates and sheets (WCSC 3316) were transported within the PSAs by water. Much of this plate and sheet tonnage originated from steel plants in the Pittsburgh area (BEA 66). The major receivers of plate and sheet were fabricating plants in Louisville (BEA 54) and Cincinnati (BEA 62).

Primary iron and steel products, nec., were also transported locally by water in significant amounts in the ORS. In 1976, 423.8 thousand tons of these primary products were shipped to local destinations via the waterway. This accounted for over 28 percent of Group VIII local waterborne traffic. The seven other commodities of Group VIII, combined, accounted for about one-third of total Group VIII local movements. Most local waterborne movements were either interplant transfers between mills or shipments of steel shapes and forms to fabricators in the Cincinnati (BEA 62) or Louisville (BEA 54) areas.

b. Inbound Movements

Inbound movements to the ORB accounted for the largest portion of waterborne iron ore, steel and iron traffic in 1976. As shown in Table 2, 2 million tons of iron and steel materials and products

entered the ORB via the waterway. This represented about 40 percent of total iron ore, steel and iron waterborne traffic. Foreign imports shipped from BEA 138, Baton Rouge and New Orleans, accounted for over 1.6 million tons, or 75 percent, of the inbound iron and steel traffic to the ORB. Iron ore and ferroalloys were the two most significant commodities of Group VIII moving into the ORB on the waterway. These commodities accounted for 36 percent and 23 percent, respectively, of total Group VIII inbound waterway movements.

c. Outbound Movements

The principal outbound commodities in Group VIII which are shipped from the ORB to points outside of the ORB in 1969-76 were pipe and tube (WCSC 3317), and plate and sheet (WCSC 3316). In 1976, these accounted for 73 percent of the outbound waterborne iron ore, steel and iron movements.

The pipe and tube movements consist primarily of oil country goods which are destined to points along the Gulf Intercoastal Waterway and to Houston (BEA 141). In 1976, these areas received 358.5 thousand tons of waterborne pipe and tube from the ORS.

Outbound movements of plates and sheet from the ORB were destined primarily for storage and distribution warehouses located along the upper and lower Mississippi River. More than 242 thousand tons were shipped in 1976. This plate and sheet originates primarily from plants located near Pittsburgh (BEA 66).

C. Intermodal Transfers

There are relatively few intermodal transfers of commodities in Group VIII. Nearly every steel plant which either receives or ships by water is located adjacent to the waterway. One exception is the Youngstown area which rails oil country pipe and tube to Aliquippa for transfer to barge. It is then moved to lower Mississippi and Gulf Coast destinations. Another inland plant, at Johnstown, PA, is expected to receive iron and steel scrap by rail after the scrap has been transferred from barge to rail at Pittsburgh.

D. Summary of Study Findings

Historical levels of consumption and production, by PSA, were estimated for each of the commodities in Group VIII on an individual commodity basis. Growth rates were applied to these historical

estimates, and production and consumption were projected by PSA through the year 2040. It should be recognized that both series, particularly consumption, are inflated due to the multi-step process of steel production. For example, iron ore is consumed in the production of pig iron which, in turn, is consumed (along with ferroalloys and scrap) in the production of steel. However, since each of the commodities is transported on the waterway, each phase of the production process had to be estimated and analyzed separately. Below is a summary of study findings concerning the consumption, production, modal split and waterway flows of iron ore, steel and iron commodities.

D-1. Consumption

Consumption of iron ore, steel and iron in the PSAs totalled 104.4 million tons in 1969. In 1973, consumption was 111.3 million tons. By 1976, it had declined to 88.7 million tons. The largest consuming area was Pittsburgh (BEA 66) which accounted for nearly 60 percent of the total consumption of iron ore, steel and iron in the PSAs. The second and third largest consuming PSAs were Youngstown (BEA 67), which accounted for 19 percent; and Cincinnati (BEA 62), which consumed 10 percent.

In the future, consumption of iron ore, steel and iron is expected to grow at an annual rate of 1.1 percent, reaching a level of 116.7 million tons by the year 2000 and 181.4 million tons by 2040. The dominance of the Pittsburgh area (BEA 66) is expected to decline through that period. Most of new growth in consumption will occur in the presently smaller consuming areas.

D-2. Production

The production of commodities in Group VIII totaled 78.3 million tons in the PSAs during 1969. Production of iron ore, steel and iron reached a high of 86.1 million tons in 1973. In 1976, however, the production of those commodities had dropped to 67.9 million tons. As was the case with consumption, the Pittsburgh area accounted for approximately 60 percent of the iron and steel production in the PSAs. Production is expected to grow at an annual rate of 1.0 percent through 2000 until it reaches a level of 85.2 million tons annually. During the period 2000-2040, production is expected to increase at an average annual rate of 0.9 percent.

D-3. Modal Split

Commodities in Group VIII are shipped by water, rail and truck modes of transportation. Rail is the principal mode. It accounts for the bulk of inbound iron ore to the area served by the ORS as well as significant tonnages of finished steel as outbound movements. Truck is the second most important mode.

The waterway system serves a relatively small but important role in the shipment of iron ore, steel and iron. Most inbound waterway movements consist of imported iron ore and ferroalloys, while outbound movements are comprised of rolled and milled steel products which are headed for lower Mississippi and Gulf Coast ports.

D-4. Waterway Flows

Gross waterway movements of iron ore, steel and iron in the Ohio River System were recorded at 5.1 million tons in 1976. As production and consumption grow in the Ohio River Basin, the volume of iron ore, steel and iron shipments is expected to increase as well. By the year 2000, total waterway movements are expected to reach 9.4 million tons per year. This represents an average annual growth rate of approximately 2.6 percent. By 2040, waterway movements are projected to be 18.1 million tons annually.

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II. MARKET DEMAND ANALYSIS

The consumption of iron ore, steel and iron in the PSAs is largely determined by the steelmaking capacity of the area. While it is projected that some growth in ORB capacity will occur in the future, most growth in the steel industry is expected to be in areas outside of the ORB. Accordingly, the growth in Group VIII consumption in the PSAs is projected to be approximately one-half of the growth in national consumption of Group VIII commodities and products.

A. Market Areas

In addition to local demand for Group VIII commodities produced in the PSAs, demand also is generated by Secondary Consumption Areas (SCAs) located outside the ORB. These SCAs are defined as BEAs which are the destinations of waterborne iron ore, steel and iron movements originating in the Ohio River Basin.

A-1. Primary Study Areas (PSAs)

This study has identified 11 BEAs or BEA segments in the ORB which either have been or will be the ultimate origins or destinations of Group VIII waterborne movements. Appendix Table B-1 presents the BEAs and BEA segments which constitute the PSAs for Group VIII, and for which iron ore, steel and iron consumption has been analyzed and projected.

A-2. Secondary Consumption Areas (SCAs)

Secondary Consumption Areas are defined as waterside BEAs outside the ORB which are the destinations of waterborne shipments originating in the ORB. Group VIII shipments to SCAs consist of

pipe and tube which are shipped to the south, and steel sheets and plates which are shipped to rolling and finishing mills in the Houston area. Each year there are also some products in Group VIII which are transported for export to New Orleans and Baton Rouge. These include steel plates and sheet as well as some iron and steel scrap. However, exports originating from the ORB are relatively insignificant components of the waterway traffic and were not analyzed or projected independently.

B. Commodity Uses

The consumption of Group VIII products falls into two usage categories. One category consists of material inputs such as iron ore, ferralloys, pig iron, and iron and steel scrap. These materials are used in the production of steel. The second category is comprised of steel mill products and foundry products which are consumed in the manufacture of finished consumer and producer goods; in the construction of bridges, buildings and other structures; and in oil well drilling, shipbuilding and similar activities.

B-1. Raw Material Inputs

The consumption of material inputs depends principally on the level of iron and steel production in the PSAs. In addition to the level of steel production, specific raw material requirements also depend on the process of steelmaking and the kinds of furnaces used by the industry.

In the PSAs, there are three principal processes by which steel is produced: (1) pneumatic, (2) electric furnace, and (3) open hearth. In addition, blast furnaces are used. They smelt iron ore into pig iron, and prepare it for usage in steelmaking furnaces.

a. Iron Ore and Concentrates

In 1976, the U.S. consumption of iron ore and concentrates was 125.4 million tons. Of that amount, 98.3 percent was consumed in blast furnaces (in the production of pig iron), 1 percent was used directly in steelmaking furnaces and 0.7 percent was used in the manufacture of other commodities.

In the same year, 1976, the consumption of iron ore in the PSAs was estimated at 35.5 million tons. Of this, 35.2 million tons, or 99 percent, were consumed by blast furnaces. Only 300 thousand tons, or 1 percent, were used directly as an iron charge in steelmaking furnaces. The amount of iron ore consumed is directly related to the level of pig iron production. An average national factor of 1.48 tons of iron ore and concentrates per ton of pig iron produced was determined for the 1969-76 period.

b. Pig Iron (Including Molten Iron)

The consumption of pig iron in steelmaking is determined, to a large degree, by the type of furnace used. In the PSAs, 23.4 million tons of pig iron were consumed during 1976. Basic oxygen furnaces were the primary consumers of pig iron. They required 15.9 million tons, or 68 percent, of all pig iron consumed in the PSAs. Open hearth steelmaking furnaces consumed 7.2 million tons, or 31 percent, while electric arc furnaces consumed 128 thousand tons, accounting for only 0.5 percent.

Factors of pig iron consumption per ton of raw steel produced were derived for each type of steelmaking furnace. Historical factors were derived from annual data presented in the American Iron and Steel Institute's (AISI) Annual Statistical Reports for the period 1969-76. Trends in pig iron consumption by furnace type were analyzed on a national basis, and factors were obtained for use in projecting future consumption of pig iron. The factors for each furnace type are as follows:

Basic oxygen furnace - .828 tons of pig iron per ton of raw steel.

Open hearth furnace - .643 tons of pig iron per ton of raw steel.

Electric arc furnace - .024 tons of pig iron per ton of raw steel.

In addition to consumption in steelmaking furnaces, approximately 150 thousand tons of pig iron were consumed by iron and steel foundries in the PSAs in 1976. Because it is sold as an end-product to foundries for use in the production of castings, instead of being consumed directly by steel mills, pig iron used by foundries is referred to as merchant pig iron. A factor relating

foundry consumption of merchant pig iron to the quantity of foundry shipments was derived on a national basis from AISI data. It was then used to project this aspect of pig iron consumption for the PSAs. In 1976, an average of 0.115 tons of merchant pig iron was consumed per ton of foundry products shipped.

c. Iron and Steel Scrap

Iron and steel scrap may be used as an alternative to pig iron for the iron charge required to feed steelmaking furnaces. As with pig iron, the quantity of iron and steel scrap consumed depends to a large degree on the type of steel furnace used. Electric and open hearth furnaces may employ ratios of scrap to pig iron of up to 100 percent. Unless the scrap is transformed into hot metal prior to charging, present technology limits the scrap ratio to 30 percent or less for basic oxygen furnaces.

In 1976, the PSAs consumed approximately 21.3 million tons of iron and steel scrap. Basic oxygen furnaces consumed 6.3 million tons, while electric and open hearth furnaces consumed 6.0 million and 5.9 million tons, respectively. Foundries were also significant consumers of iron and steel scrap in the PSAs. They required 2.1 million tons in 1976. Some iron and steel scrap is fed into blast furnaces along with iron ore; and in 1976, it was estimated that blast furnaces in the PSAs consumed slightly over 1.0 million tons of scrap.

d. Ferroalloys

Depending on the ultimate use, ferroalloys are used in steel production to provide specific qualities to the steel. The most commonly used ferroalloy, ferromanganese, is added to steel to counteract the harmful effect of sulfur and to increase the hardness and strength of the steel. Other metals and alloys such as silicon, boron, chromium, nickel and tungsten are added to steel to improve either corrosion resistance, strength, hardness or to make steel resistant to high temperatures.

The PSAs consumed approximately 577 thousand tons of ferroalloys in 1976. The two largest consuming areas were BEAs 66 (Pittsburgh) and 67 (Youngstown) which used 364 thousand and 108 thousand tons, respectively.

B-2. Steel Mill and Foundry Products

Steel products are used in virtually all manufacturing processes. Table 4 presents the consumption of steel products in 1976 by market classification. The automotive industry is the largest single consumer of steel, using 21.3 million tons and accounting for 23.9 percent of total U.S. consumption of domestic steel products in 1976. The construction industry is the second largest consumer of steel products. In 1976, products made directly for construction usage accounted for 14.6 million tons, or 13.4 percent of domestic production. In addition, steel service centers and distributors accounted for 14.6 million tons. Much of that was eventually consumed by small contractors and builders in the construction industry. Thus, the total market share attributable to construction was probably close to 20 percent of the total domestic production in the United States.

Other major steel-consuming industries in 1976 included machinery, 5.8 percent; transportation (other than automotive), 4.5 percent; containers, 7.7 percent; and oil and gas, 3.0 percent. Of interest to the Ohio River Basin were the 2.7 million tons of steel consumed by the oil and gas industry in 1976. The PSA is a major producer of steel pipe and tube, and annually ships about 500 thousand tons of pipe and tube via the waterway to the oil producing states in the South and Southwest.

C. Consumption Characteristics

The consumption of Group VIII products is basically derived from the demand for finished steel products. Given the level of finished steel demand, however, there are also economic, technological, and institutional considerations which influence the consumption of raw and secondary material inputs, as well as of individual steel products.

C-1. Raw Material Inputs

The level of steel production is the single most important determinant of demand for iron ore and iron and steel scrap. The proportions of scrap and pig iron used for steelmaking depends on furnace type. The proportion of scrap used by each type of furnace, as well as the share of steel production by furnace type during 1969-76, is shown in Table 5. The share of total steel production provided by basic oxygen furnaces (which use an average of 71 percent pig iron) increased from 42.6 percent to 62.4 percent

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Table 4. United States: Net Shipments of Steel Products by Market Classifications, 1976

(Thousands of net tons unless otherwise specified)

Market classification	Quantity	Percent of total
Total shipments	89,447	100.0
Automotive	21,351	23.9
Steel service centers and distributors	14,615	16.3
Construction and contractor's products	12,010	13.4
Containers, packaging, and shipping materials	6,914	7.7
Machinery, industrial equipment and tools	5,180	5.8
Steel for converting and processing	4,036	4.5
Rail transportation	3,056	3.4
Electrical equipment	2,671	3.0
Oil and gas industry	2,653	3.0
Appliances, utensils, and cutlery	1,950	2.2
Agricultural	1,784	2.0
Other domestic uses[a]	5,460	6.1
Exports	1,839	2.1
Unclassified shipments	5,928	6.6

a. Includes independent forgers, industrial fasteners, shipbuilding, aircraft and ordnance.
Source: American Iron and Steel Institute, Annual Statistical Report, 1976 ed.

Table 5. United States: Steel Production and Scrap Charge by Furnace Type; Percent of Total Steel Production by Furnace Type, and Scrap Percentage of Total Charge for Each Type, Estimated 1969-76

Year	Furnace type: Basic oxygen		Electric		Open hearth		Total	
	Steel production	Scrap charge	Steel production	Scrap charge	Steel production	Scrap charge	Steel production	Scrap charge
1969	42.6	29.9	14.3	98.6	43.1	45.1	100.0	50.0
1970	48.1	30.1	15.4	98.1	36.5	41.4	100.0	48.7
1971	53.1	27.8	17.3	96.8	29.6	44.4	100.0	50.5
1972	56.0	28.7	17.8	96.9	26.2	45.7	100.0	51.2
1973	55.2	28.7	18.4	96.2	26.4	44.7	100.0	50.5
1974	56.0	28.5	19.6	96.8	24.4	46.0	100.0	52.1
1975	61.6	28.3	19.5	96.7	19.0	44.7	100.0	50.8
1976	62.4	28.4	19.2	98.1	18.4	46.8	100.0	50.8

Source: Institute of Scrap Iron and Steel, Inc., Facts, 1976 ed.

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of total steel production during the 1969-76. However, the increased usage of pig iron resulting from increased basic oxygen furnace production was matched by increased scrap usage in expanding electric furnace production. Production from electric furnaces (which use scrap as approximately 98 percent of the charge) increased from 14 percent to 19 percent of total steel output between 1969 and 1976. The open hearth furnace (using an average of 45 percent scrap) was largely phased out during the period. Open hearth production declined from 43 percent in 1969 to 18 percent in 1976. Therefore, the net change in the proportion of scrap and pig iron consumed in steelmaking between 1969 and 1976 was not significant.

Other considerations influencing the demand for scrap iron and iron ore are (1) the investment in iron ore reserves and direct reduction plants by many of the steel companies; (2) the availability of scrap; and (3) the relative cost of scrap and iron ore.

C-2. Steel Mill and Foundry Products

The consumption of steel mill and foundry products is determined chiefly by the demand for the finished goods for which steel is a material input. Thus, to a large degree, the levels of metal fabrication and of construction activity (the two principal steel consuming industries) determine the demand for steel products.

D. Existing Aggregate Demands

The consumption of iron ore, steel and iron fluctuates from year to year in the PSAs according to national demand for steel products. The national demand for steel products is, in turn, affected by the general economic conditions existing in the Nation. In particular, the sensitivity of the automotive, construction and other steel consuming industries to economic conditions is a major determinant of the national demand for steel and steel products. In 1969, consumption of iron ore, steel and iron totalled 104.2 million tons in the PSAs (Table 6). In 1973, total consumption had increased to 111.1 million tons. Consumption by product is presented in Appendix Tables A-1 through A-6. In 1976, however, total iron ore and steel consumption was only 89.4 million tons. This follows the decline in national steel production for that year.

Table 6. Ohio River Basin: Consumption of Iron Ore, Iron and Steel, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	104,188.5	96,025.6	88,638.5	99,845.2	111,092.8	108,882.0	82,458.1	89,416.1
BEA 47: Huntsville, AL	45.2	39.6	43.5	45.7	52.1	50.5	38.0	43.1
BEA 48: Chattanooga, TN	1,034.0	913.4	909.2	996.6	1,121.1	1,060.8	837.4	936.7
BEA 49: Nashville, TN	561.6	512.6	535.0	565.3	644.8	622.5	471.4	532.8
BEA 50: Knoxville, TN	464.8	412.5	400.3	463.0	516.9	508.7	384.6	439.4
BEA 52: Huntington, WV	7,303.8	6,989.6	6,889.0	7,125.0	8,347.5	7,716.7	5,731.1	6,457.8
BEA 54: Louisville, KY	1,115.2	1,021.9	1,072.2	1,128.4	1,286.9	1,247.3	940.2	1,064.2
BEA 55: Evansville, IN	553.8	511.9	530.7	581.3	648.8	620.9	463.5	536.4
BEA 62: Cincinnati, OH	9,733.7	9,238.5	9,220.4	10,197.7	10,627.5	10,447.5	7,751.5	8,744.5
BEA 64: Columbus, OH	139.5	127.8	134.1	141.1	161.0	156.0	117.5	133.1
BEA 66: Pittsburgh, PA	63,679.1	57,629.6	52,643.8	60,033.2	67,082.5	66,031.9	50,709.1	53,704.5
BEA 67: Youngstown, OH	19,557.8	17,628.0	16,260.3	18,567.9	20,603.7	20,419.2	15,013.8	16,823.6

Note: Consumption figures shown include the consumption of iron ore, pig iron, steel mill products, ferroalloys, ferrous castings and ferrous scrap.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Consumption of iron ore, pig iron, steel mill products, ferroalloys, ferrous castings and ferrous scrap are shown annually by BEA segments in Table A-1 through A-6.

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D-1. Raw Material Inputs

In terms of tonnage consumed, iron ore and concentrates were the largest components of Group VIII in the PSAs in 1976. Approximately 35.5 million tons of iron ore and concentrate were utilized by ORB hinterland steel plants. This accounted for 39 percent of the total consumption of commodities in Group VIII (Table 7).

Pig iron and iron and steel scrap were also important elements of Group VII consumption. These two commodities are substitutable to some extent as iron charges in the steelmaking furnaces, and their combined consumption in the PSAs in 1976 was 44.8 million tons. That tonnage amounts to just about half of total Group VIII consumption (89.5 million tons) that year.

D-2. Steel Mill and Foundry Products

The consumption of steel mill and foundry products is more widely dispersed throughout the PSAs than that of other commodities in the iron ore, steel and iron group. This is due to the use of steel mill and foundry products by fabricating and manufacturing plants which are located throughout the region. Iron ore, ferroalloys, and iron and steel scrap are generally consumed at integrated steel plants.

Most of the consumption of steel mill products in 1976 occurred in the four major steel producing PSAs: Pittsburgh, Youngstown, Cincinnati and Huntington. While only 6.0 million tons of steel mill products, or 69 percent of total steel mill products, were consumed in these PSAs, they accounted for 96 percent of total iron ore, steel and iron consumption in the area served by the ORS (Table 7).

E. Forecasting Procedures and Assumptions

In projecting future levels of iron ore, steel and iron consumption in the PSAs, existing projections of steel demand in the United States were identified and analyzed. There are many projections of U.S. steel demand available; however, most of the industrial and financial forecasts are for the relatively short term (i.e., for either 1982 or 1985) and do not provide for mid- and long-term projections through the years 2000 and 2040.

Table 7. Ohio River Basin: Consumption of Iron Ore, Iron and Steel by Commodity and BEAs or BEA Segments,[a] Estimated 1976

(Thousands of tons)

BEA and BEA segment		Iron ore and concentrates	Pig iron	Steel mill products	Ferroalloys	Foundry products	Iron and steel scrap	Total
Primary Study Areas		35,487.3	23,438.1	7,446.9	577.0	1,207.7	21,259.1	89,416.1
BEA 47:	Huntsville, AL	--	--	37.1	--	6.0	--	43.1
BEA 48:	Chattanooga, TN	--	40.7	264.1	10.9	42.8	578.2	936.7
BEA 49:	Nashville, TN	--	2.4	426.7	.6	69.2	33.9	532.8
BEA 50:	Knoxville, TN	2.3	6.1	122.5	3.9	19.9	284.7	439.4
BEA 52:	Huntington, WV	3,181.2	1,716.8	201.7	38.1	32.7	1,287.3	6,457.8
BEA 54:	Louisville, KY	--	--	915.6	--	148.6	--	1,064.2
BEA 55:	Evansville, IN	1.2	3.3	326.0	2.1	52.0	151.8	536.4
BEA 62:	Cincinnati, OH	2,987.4	2,026.4	1,618.3	49.8	262.7	1,799.9	8,744.5
BEA 64:	Columbus, OH	--	--	114.5	--	18.6	--	133.1
BEA 66:	Pittsburgh, PA	22,481.2	14,999.6	2,453.1	364.0	398.2	13,008.3	53,704.5
BEA 67:	Youngstown, OH	6,834.0	4,642.7	967.3	107.6	157.0	4,115.0	16,823.6

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Iron ore consumption from Table A-1 . Pig iron consumption from Table A-2. Steel production consumption from Table A-3. Ferroalloy consumption from Table A-4. Foundry consumption from Table A-5. Iron and steel scrap consumption from Table A-6.

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In studying the forecasts, several questions were raised concerning the appropriateness of a forecast for projected steel activity in the PSAs. Specifically, the major concerns were: (1) the forecast period (projections for the study were to extend through 2040); (2) the treatment of steel imports in the forecast, which in recent years have been at very high levels; (3) the applicability of the national forecast for regionalized projections in the PSAs; (4) the average annual rate of growth for apparent steel supply presented by each forecast.

A summary of the various available forecasts for apparent steel supply is presented below.

Source	Average annual rate of growth	Forecast period
American Iron and Steel Institute	2.25	1976-1983
Bureau of Mines	1.60	1976-2000
Federal Trade Commission	1.95	1974-1985
Fordham University	2.10	1974-1982
OBERS	2.09	1971-1980
OBERS	1.38	1980-1990
OBERS	1.53	1990-2000
OBERS	1.46	2000-2020
Major steel producer (confidential)	2.20	1974-1990

Of these supply forecasts, only OBERS projects steel growth through 2020, while the Bureau of Mines and the industry source projections forecast through 2000 and 1990, respectively.

All other forecasts were for the short term, and although they were considered in the analysis, longer term projections were required for projection purposes. Therefore, the projections of the Bureau of Mines and the major steel producer, as well as those of OBERS, were considered for use in this study.

The Bureau of Mines used standard regression techniques to establish a trend from 1915-1976. The Bureau of Census population series I-III was used for these projections. Imports were assumed to account for fifteen percent of total domestic consumption each

year. Exports were assumed to continue to account for an average of 3 percent of steel demand throughout the forecast period.

The projections obtained from the steel producer were derived from forecasts of steel demand by major use categories which were aggregated into a total steel demand forecast. They also assumed steel imports would account for 15 percent of the domestic consumption throughout this forecast period.

OBERS projects earnings in the major manufacturing sectors of the U.S. economy through the year 2020. It projects growth in earnings in the primary metals industry of the United States to be at an average annual rate of 2.1 percent through 1980. It will, according to OBERS, slow to an average annual rate of 1.6 percent by 2000. In terms of the geographic areas in the United States, OBERS projects earnings for individual BEAs. The OBERS BEA projections of earnings in the primary metals industry are consistent with the judgments of most the government and industry authorities consulted during the course of this study. It was, therefore, judged that the OBERS projections, prepared by the U.S. Department of Commerce for the U.S. Water Resources Council, would provide the most accurate basis for projecting steel consumption and production in the PSAs.[1]

No projections of industrial activity beyond the year 2020 were identified. Therefore, a decrease in the rate of change experienced in the period 2000-2020 was assumed, based on the premise that constraints to growth become more pronounced as growth occurs.

The OBERS projections are based on long-run or secular trends and ignore cyclical fluctuations which characterize many of the short-run forecasts of the economy. The general assumptions that underlie the projections are as follows:

(1) Population growth is estimated according to the Census Bureau 1972 Series E national population projections.

(2) A national unemployment rate of 4 percent is assumed to prevail until 2020.

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1. U.S. Water Resources Council, OBERS Projections, Series E, 1972 ed. (Washington, D.C.: GPO, 1974).

(3) Technological progress and capital accumulation is assumed to support a growth in private output per manhour of 2.9 percent annually.

(4) For regional forecasts, most regional factors are expected to converge slowly toward the national norm.

Based on the OBERS earnings projections, the mix of raw steel production, by kind of steelmaking furnaces, was projected for each PSA. Taking into account technological developments, such as the continuous casting process and the direct-reduction of iron ore, factors were applied to raw steel production requirements to determine the future consumption of the raw and secondary materials for each BEA segment.

The consumption of steel mill and foundry products was based on the growth of the three major manufacturing sectors of the economy that consume steel. The growth rates utilized were also obtained from the OBERS projections of the individual BEA's earnings in those manufacturing sectors.

Other assumptions inherent in the projections of iron ore, steel and iron consumption are that: (1) because of political and economic pressures, imports of steel products will be maintained at 15 percent of the total U.S. demand; (2) although steel growth is expected to be strongest in other regions of the United States and because of the lack of capital to close older facilities and build totally new plants elsewhere, existing plants in the PSAs have satisfied or will satisfy environmental concerns and plants will be maintained and upgraded; and (3) current environmental and other regulatory factors influencing the kinds of steelmaking furnaces used will not change.

F. Probable Future Demands

The total consumption of iron ore, steel and iron in the PSAs is projected to grow at an average annual rate of 1.1 percent through the year 2040 (Table 8). The Pittsburgh area (BEA 66), the largest consuming PSA, is expected to grow at an annual rate of only 0.8 percent, while many of the smaller PSAs will have a somewhat higher growth rate during the projection period. Consumption of iron ore, steel and iron in the Youngstown area (BEA 67) is expected to decline through 1990. This is because a major steel plant closed in that area after 1976. However, the remaining

Table 6. Ohio River Basin: Consumption of Iron Ore, Iron and Steel Products by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	89,416.1	100,662.6	101,286.0	116,005.2	155,314.8	183,544.2	1.1	1.1
BEA 47: Huntsville, AL	43.1	55.3	84.0	123.9	236.2	326.9	4.5	2.5
BEA 48: Chattanooga, TN	936.7	1,177.2	1,613.1	2,156.0	3,581.0	4,672.1	3.4	2.0
BEA 49: Nashville, TN	532.8	707.7	1,154.2	1,754.0	3,454.9	4,869.9	5.1	2.6
BEA 50: Knoxville, TN	439.4	527.4	687.1	894.8	1,440.8	1,851.2	3.0	1.8
BEA 52: Huntington, WV	6,457.8	7,880.5	8,947.4	10,638.8	14,613.0	17,242.9	2.6	1.2
BEA 54: Louisville, KY	1,064.2	1,390.2	2,204.9	3,311.2	6,425.0	8,983.3	4.8	2.5
BEA 55: Evansville, IN	536.4	675.0	961.7	1,339.8	2,347.4	3,123.8	3.7	2.1
BEA 62: Cincinnati, OH	8,744.5	10,415.9	10,725.7	12,663.0	17,887.8	21,394.4	1.6	1.3
BEA 64: Columbus, OH	133.1	162.5	222.3	303.1	508.4	659.5	3.5	2.0
BEA 66: Pittsburgh, PA	53,704.5	61,401.4	58,791.7	64,130.1	79,040.1	90,153.0	0.8	0.8
BEA 67: Youngstown, PA	16,823.6	16,269.9	15,893.9	18,690.5	25,780.2	30,267.2	0.4	1.2

Note: Consumption of iron ore, iron and steel products was projected for 1980-2040 on an individual commodity basis. Consumption totals shown include iron ore consumption from Table A-7, pig iron consumption from Table A-8 and steel consumption from Table A-9, iron and steel scrap consumption from Table A-12 ferroalloy consumption from Table A-10 and foundry consumption from Table A-11.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Consumption of the iron ore, iron and steel commodity group shown in Tables A-7 through A-12 for 1976, 1980, 1990, 2000, 2020 and 2040, respectively.

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plants in BEA 67 are projected to increase consumption at an average annual rate of 1.2 percent through 2040.[1]

Projections of consumption by product are presented in Appendix Tables A-7 through A-12. The consumption of iron ore, steel and iron by the steel industry was estimated for the PSAs based upon projections of raw steel production by furnace type for individual BEA or BEA segments. Factors relating the consumption of the products by furnace type were derived nationally from AISI data and were applied to the PSAs. The national factors obtained were adjusted to account for technological and economic changes such as the further implementation of continuous casting in the steelmaking process and the increased usage of direct reduced ore in electric and other steelmaking furnaces.

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1. Since the time these projections were prepared (early 1979), the steel industry has experienced some plant shutdowns and reallocation of production by plant. Such temporary aberrations are expected, but specific accounting for these cannot be made in this long-range economic analysis.

III. COMMODITY RESOURCE INVENTORY

The Ohio River Basin is one of the major steel producing areas in the United States. Although in recent years it has lost its position as the predominant steel producing district in the United States, it is still one of the most important industries in the ORB.

A. Production Areas

The production of Group VIII commodities in the PSAs is supplemented by production in Secondary Production Areas (SPAs) located outside the Ohio River Basin. These SPAs are defined as BEAs which are the origins of Group VIII waterborne movements destined to the Ohio River Basin.

A-1. Primary Production Areas (PSAs)

This study has identified 11 BEAs or BEA segments in the ORB which either have been or will be the ultimate origins or destinations of Group VIII waterborne movements. Apppendix Table B-1 presents the BEAs and BEA segments which constitute the PSAs for Group VIII, and for which iron ore, steel and iron consumption has been analyzed and projected.

A-2 Secondary Production Areas (SPAs)

Major shipments to the ORB from SPAs consist of imported iron ore, ferroalloys and steel products. In addition, some iron and steel scrap is transported into the ORB from the surrounding hinterlands.

B. Production Characteristics

The production of iron ore, steel and iron has undergone many changes in the past few decades. Factors underlying these changes may be characterized as economic, technological, and institutional factors.

B-1. Economic Factors

A major change in the production of steel in the past 25 years has been the establishment of new steelmaking facilities in the Midwest and West. This can be seen from Table 9 which presents annual raw steel production for eleven geographic districts in the United States.

In 1948, the five eastern districts, Northeast Coast, Buffalo, Pittsburgh, Youngstown and Cleveland, produced over 54 million tons of raw steel and accounted for 61 percent of the nation's production. By 1968, these five districts produced slightly over 69 million tons of raw steel. This, however, accounted for only 53 percent of the U.S. total. The industry growth in western and southern districts, one of the causes for this decline, was maintained through the 1970s. As a result, by 1976, the five eastern districts (which in 1948 accounted for 61 percent of the Nation's raw steel production) accounted for only 46 percent of the Nation's total.

Another way to view the geographical shift in production is to look at the net additions to steel production by district. Between 1948 and 1976, the five eastern regions increased their raw steel production by only 5.5 million tons, whereas the western and southern districts increased by over 34.6 million tons.

One of the major reasons cited for the westward shift in production is that changing economic conditions induced the location of steel mills nearer to steel markets. This contrasts with the economics which had induced locating near the resources required for steel production. Thus, market areas for steel, such as the Chicago and Detroit automotive and machinery producing centers, can account for much of the new raw steel capacity and production in the Midwest. For example, these two districts produced 21.3 million tons of raw steel in 1948, but by 1976 their output had increased to 41 million tons. This represented a shift in their portion of the Nation's output from 24 percent in 1948 to 32 percent in 1976.

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Table 9. United States: Production of Raw Steel, by Geographical District, Selected Years, 1948-76

(Thousands of tons unless otherwise specified)

U.S. and geographical district	1948	1952	1956	1960	1964	1968	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change 1948-68	Average annual percentage change 1968-76
United States	88,639	93,217	115,230	99,256	127,114	131,497	141,206	131,538	120,216	133,241	150,799	145,720	116,642	127,943	2.0	(0.3)
Northeast Coast	11,037	11,596	16,486	14,390	17,743	18,022	19,221	18,163	16,400	15,959	18,608	17,834	13,597	14,484	2.5	(2.6)
Buffalo	4,377	4,836	6,312	5,192	6,057	7,228	7,470	5,786	4,321	4,113	6,455	5,562	3,489	4,794	2.5	(5.0)
Pittsburgh	22,999	23,421	25,742	20,045	25,320	25,320	27,063	24,625	22,431	25,146	28,222	27,856	21,511	22,786	0.5	(1.3)
Youngstown	11,554	11,465	12,354	8,355	10,932	10,754	11,880	10,098	8,910	10,146	11,609	11,139	7,968	9,275	0.4	(1.8)
Cleveland	4,066	4,502	5,760	5,567	7,213	7,746	7,867	7,060	6,590	8,275	9,126	8,848	7,420	8,411	3.3	1.0
Detroit	3,456	4,608	6,254	6,528	9,436	9,271	10,029	9,569	9,016	9,408	10,951	10,468	9,031	10,393	5.1	1.4
Chicago	17,798	17,603	22,688	20,733	26,209	26,796	29,333	28,276	25,897	30,326	34,171	33,331	27,275	30,631	2.1	1.7
Cincinnati	2,760	3,076	4,810	3,981	5,560	6,112	6,460	6,229	6,172	6,816	7,316	6,797	5,072	5,734	4.1	(0.8)
St. Louis	1,483	1,869	2,748	2,666	3,380	3,078	3,485	3,680	3,680	4,045	4,155	4,050	3,269	4,169	3.7	3.9
Southern	4,364	4,591	5,441	5,668	7,312	8,502	9,563	9,647	9,064	10,207	10,739	10,627	10,140	9,386	3.4	1.2
Western	4,707	5,746	6,663	6,174	7,825	8,619	8,862	8,448	7,702	8,074	9,402	9,208	7,870	7,880	3.1	(1.1)

Source: American Iron and Steel Institute.

Two of the three American Iron and Steel Institute (AISI) geographic districts which lie within the Ohio River Basin, Pittsburgh and Youngstown, actually showed declining production of raw steel between 1948 and 1976. In 1948, the combined raw steel production for these two districts was 34.5 million tons, or 39 percent of the Nation's total. In 1976, however, these two regions produced only 32.1 million tons of raw steel. This represented only 25 percent of the Nation's total production that year.

The shift in the Nation's steel production toward major steel consuming areas in the Midwest and the Sunbelt is expected to continue throughout the projection period. This is due to the continuing trend of locating new steel plants near the markets for steel products which, in turn, reflects a geographic shift in population to these regions. To a degree, this shift is offset by the desire to minimize the distance of movement for raw materials. Steel production growth in the Pittsburgh area is expected to be somewhat below the national growth. It will increase slightly, however, as plants finish rounding out their steelmaking facilities. Limited growth in the Pittsburgh area will occur because of additions to present capacities at several plants. No new integrated or semi-integrated steel mills are anticipated for the forecast period.

B-2. Technological Changes

In the United States, during the last two decades, the production process for raw steel has shifted from open hearth and Bessemer furnaces to basic oxygen and electric arc furnaces (Table 10). In the PSAs, the basic oxygen furnace is the predominant method of producing raw steel (Table 11).

It is expected that the replacement of the open hearth furnace by electric and basic oxygen furnaces will occur at a more rapid rate in the PSAs than in the Nation in general. This is due to the phasing out of many of the region's older open hearth furnaces which are less desirable producers of steel in terms of manhour and raw material requirements and in terms of pollution emissions. There are two major electric furnaces that are expected to be totally operational by 1985. One has already been installed by Jones and Laughlin Steel Corporation at their Pittsburgh works. It has an annual capacity of over 2 million tons of raw steel and became operational in 1979. A similar facility is planned by Bethlehem Steel Corporation at Johnstown, Pa. This facility is expected to become operational around 1985.

Table 10. United States: Production of Raw Steel by Furnace Type
Selected Years 1948-76

(Thousands of tons unless otherwise specified)

Total and furnace type	1948	1952	1956	1960	1964	1968	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change 1948-68	Average annual percentage change 1968-76
Total	88,640	93,168	115,216	99,282	127,076	131,462	141,262	131,514	120,443	133,241	150,799	145,720	116,642	128,000	2.0	(0.3)
Open hearth	79,340	82,846	102,841	86,368	98,098	65,836	60,894	48,022	35,559	34,936	39,780	35,499	22,161	23,470	(0.9)	(12.1)
Bessemer	4,243	3,524	3,228	1,189	858	a	--	--	--	--	--	--	--	--	--	--
Basic oxygen	--	--	506	3,346	15,442	48,812	60,236	63,330	63,943	74,584	83,260	81,552	71,801	79,918	--	6.4
Electric	5,057	6,798	8,641	8,379	12,678	16,814	20,132	20,162	20,941	23,721	27,759	28,669	22,680	24,612	6.2	4.9

a. Included with open hearth.
Source: American Iron and Steel Institute, Annual Statistical Report, 1968 and 1976 eds.

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Table 11. Ohio River Basin: Raw Steel Production by BEAs or BEA Segments[a] and Type of Furnace, Estimated 1969-76

(Thousands of tons)

BEA and BEA segment and furnace type	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	41,034.9	38,730.8	35,745.4	40,159.3	44,567.7	43,529.5	33,174.4	35,834.8
Basic oxygen	27,874.8	20,768.3	19,179.3	21,450.9	23,917.9	23,357.4	17,958.0	19,217.9
Electric arc	6,287.7	5,802.2	5,332.0	5,964.1	6,526.5	6,373.1	4,899.1	5,243.2
Open hearth	13,239.8	12,160.3	11,234.1	12,744.3	14,005.8	13,676.5	10,220.5	11,270.0
BEA 50: Knoxville, TN	304.5	277.1	252.2	282.9	317.3	313.5	243.3	258.3
Basic oxygen	--	--	--	--	--	--	--	--
Electric arc	304.5	277.1	252.2	282.9	317.3	313.5	243.3	258.3
Open hearth	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	2,836.1	2,734.0	2,707.5	2,991.9	3,230.7	2,980.6	2,226.4	2,516.8
Basic oxygen	1,723.8	1,661.7	1,645.6	1,818.4	1,963.8	1,811.7	1,353.2	1,529.9
Electric arc	336.1	324.1	320.9	354.7	382.8	353.2	263.9	298.2
Open hearth	776.2	748.2	741.0	818.8	884.1	815.7	609.3	688.7
BEA 55: Evansville, IN	152.2	149.6	148.1	163.7	176.7	163.0	121.8	137.7
Basic oxygen	--	--	--	--	--	--	--	--
Electric arc	152.2	149.6	148.1	163.7	176.7	163.0	121.8	137.7
Open hearth	--	--	--	--	--	--	--	--
BEA 62: Cincinnati, OH	3,469.8	3,372.0	3,312.6	3,659.9	3,953.7	3,646.7	2,725.4	3,079.1
Basic oxygen	1,724.1	1,662.0	1,645.9	1,818.8	1,964.0	1,811.9	1,354.0	1,530.0
Electric arc	452.6	463.4	432.1	477.5	516.6	475.7	355.8	401.5
Open hearth	1,293.1	1,246.6	1,234.6	1,363.6	1,473.1	1,359.1	1,015.6	1,147.6

(Continued)

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Table 11. (Continued)

BEA and BEA segment and furnace type	1969	1970	1971	1972	1973	1974	1975	1976
BEA 66: Pittsburgh, PA	27,002.8	24,570.1	22,380.7	25,271.2	28,152.3	27,794.1	21,462.9	22,734.4
Basic oxygen	16,045.1	14,599.7	13,298.6	14,908.6	16,732.3	16,515.3	12,753.3	13,506.5
Electric arc	4,203.3	3,824.6	3,483.9	3,905.6	4,376.4	4,326.5	3,340.9	3,539.7
Open hearth	6,754.4	6,145.8	5,598.2	6,457.0	7,043.6	6,952.3	5,368.7	5,688.2
BEA 67: Youngstown, OH	8,381.8	7,628.0	6,944.3	7,789.7	8,737.0	8,631.6	6,394.6	7,108.5
Basic oxygen	3,126.7	2,844.9	2,589.2	2,905.1	3,257.8	3,218.5	2,497.5	2,651.5
Electric arc	839.0	763.4	694.8	779.7	874.2	863.7	670.2	711.5
Open hearth	4,416.1	4,019.7	3,660.3	4,104.9	4,605.0	4,549.4	3,226.9	3,745.5

Note: Table compiled by RRNA using raw steel production figures by geographical districts obtained from the American Iron and Steel Institute. Production levels for individual BEAs and BEA segment were computed by modifying geographical district totals according to the individual plant production levels which were based on RRNA estimates of individual plant capacities by furnace type.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Estimated by RRNA from the following sources: American Iron and Steel Institute, Raw Steel Production by Geographical Districts, 1969-76 eds.; American Iron and Steel Institute, Directory of Iron and Steel Works in the United States and Canada, 1967 ed.; Institute of Iron and Steel Studies, Commentary, Feb. and Mar. 1973; Basic Oxygen Process Association, L-D Process Newsletter, Zurich, Switzerland, June 1979.

Another factor which might strongly affect the future of steel production, both in Pittsburgh and in the entire region, is the possible installation of an integrated steel operation in the Conneaut, Ohio area by the U.S. Steel Corporation. U.S. Steel has tentative plans to construct a fully integrated operation at this site, adjacent to Lake Erie. This installation could result in a substantial shift of steel production from the Pittsburgh area. However, officials at U.S. Steel have indicated that they are confronted by many environmental and financial problems, thereby making the construction of the plant questionable. Accordingly, the plant has not been included in our projections of future production in the PSAs.

The continuous casting process for the rolling and milling of steel products is a technological innovation that has been widely implemented in recent years. The process of pouring molten steel between two closely spaced horizontal rolls was first conceived by Sir Henry Bessemer around 1860. However, the engineering materials of his era were not adequate to make the process successful. In the 1960s, the technology was further developed so that semi-finished shapes could be continuously cast, and the ingot and primary-mill stages of rolled-steel production could be eliminated. This process results in a higher yield from raw steel to finished steel and, therefore, it saves resources and reduces energy costs.

The direct reduction of iron ore is another technological change that may be further developed during the projection period. Direct-reduced iron ore, sometimes referred to as sponge iron, serves as a substitute for scrap and cold pig iron in the steelmaking process. To date, there has been no commercial direct-reduction process developed that would supplant the blast furnace as the chief producer of iron units in steelmaking on a large scale. This is because most of the current successful direct-reduction processes require natural gas in large amounts as a reducing agent. If the technological problems of gasification and liquefaction of coal are overcome, there could be more iron ore in the United States reduced directly. At present, however, it is generally agreed that most of the direct-reduced iron will originate in the iron- and gas-abundant countries of South America, specifically Venezuela and Brazil.

C. Feedstocks and Raw Materials

The United States has an abundant supply of most of the materials required for the production of iron and steel. The major exception is manganese ore, which the United States imports primarily from Brazil, Gabon and Australia.

C-1. Iron Ore

Iron is the fourth most abundant rock-forming element on earth, comprising about 5 percent of the earth's crust. A small part of this iron has been concentrated by sedimentary, igneous or metamorphic processes into deposits with an average iron content of 68 percent.

Iron ore is a mineral substance which, when heated in the presence of a reductant, will yield metallic iron. In commercial terms, the mineral must be economically minable in order to be called iron ore; otherwise, it is referred to as iron-bearing rock, lean ore or waste rock.

In the United States, there are known deposits of iron ore in 27 states. Although there are some iron ore deposits in New York, Pennsylvania, Tennessee, Missouri and several western mountain states, the principal source of iron in the United States is the Lake Superior Region.

Identified reserves and resources of iron ore in the United States are presented in Table 12. Reserves are defined as those resources that can be mined profitably under present economic conditions. As can be seen from Table 12, Minnesota, Michigan, and Wisconsin possess over 93 billion tons of iron ore resources, nearly 81 percent of the national total. Other states possessing substantial iron ore resources include Alaska and Alabama, with almost 6.5 billion and 5.2 billion tons, respectively.

There are virtually no known reserves of iron ore located within the PSAs. Thus, since the area is a major consumer of iron ore, large movements of ore enter the PSAs from the Great Lakes region and foreign sources.

C-2. Iron and Steel Scrap Resources

With the increasing usage of scrap-intensive electric furnaces to produce steel, there has been much controversy as to the availability and potential reserves of iron and steel scrap in the United States.

In 1975, it was estimated that the United States possessed an iron and steel scrap inventory of 636.2 million tons. In addition, it was estimated that the inventory increased by an average 13.5 million tons annually between 1956 and 1975. This inventory, consisting of junked automobiles, discarded rails, and other forms

Table 12. United States: Identified Reserves and Resources[a] of Iron Ore by Region and State, 1976.

(Millions of long tons)

Region and state	Reserves	Resources	Total
United States	16,968	102,128	119,096
Lake Superior region	16,045	81,060	97,105
Michigan	2,000	35,665	37,665
Minnesota	6,000	41,395	47,395
Wisconsin	---	4,000	4,000
Undistributed	8,045	---	8,045
Northeastern region	200	1,170	1,370
New Jersey	---	16	16
New York and Pennsylvania	200	837	1,037
Maine	---	317	317
Southeastern region	22	9,270	9,292
Alabama	---	5,214	5,214
Georgia	22	2,045	2,067
Tennessee	---	1,503	1,503
Virginia	---	492	492
Mississippi	---	16	16
Central Gulf region	274	373	647
Louisiana	---	162	162
Missouri and Texas	274	209	483
Oklahoma	---	2	2
Central Western region	162	2,053	2,215
Colorado	7	98	105
Montana	---	349	349
New Mexico	---	139	139
South Dakota	---	493	493
Wyoming	75	628	703
Utah	80	346	426
Western region	265	8,202	8,467
Alaska	---	6,500	6,500
Arizona	---	542	542
California	260	---	260
Hawaii	---	985	985
Nevada	5	163	168
Oregon	---	4	4
Washington	---	8	8

a. Reserves are defined as chose resources that can be profitably mined under present economic conditions. Resources are other iron-bearing materials that may be profitable to mine under future economic conditions.

Source: U.S. Department of the Interior, Bureau of Mines, Mineral Commodity Profile: Iron Ore, 1978.

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of obsolete scrap, is considered to be recoverable with the use of existing technology at high but realistic prices (that is at prices several times higher than present levels). Table 13 displays the iron and steel scrap inventory in 1975 for the nine U.S. Department of Commerce Census Regions. Although there are no data available pertaining solely to the PSAs, a significant portion of this inventory is thought to exist in the PSAs. In addition to obsolete scrap, much scrap metal is generated by the steel and manufacturing industries annually.

D. Existing Production Levels

The Ohio River Basin contains several of the major iron and steel producing districts of the United States. In 1976, it accounted for approximately 30 percent of the national steel production. The largest iron and steel production PSA is BEA 66 (Pittsburgh) which, during the 1969-76 period, produced an average of 45.0 million tons of iron and steel product, or approximately 60 percent of the PSA total (Table 14).[1] Production by product is presented in Appendix A. Other major iron and steel producing PSAs are BEA 67 (Youngstown), BEA 62 (Cincinnati) and BEA 52 (Huntington).

Shipments of iron ore from U.S. mines are shown in Table 15 for the period 1969 through 1976. Total shipments fluctuated during the study period, ranging from 90.6 million tons in 1973 to 75.6 million long tons in 1975. Shipments of Minnesota iron ore averaged roughly 65 percent of the total U.S. production and reached a peak of 62.6 million tons in 1973. There was no production of iron ore in the PSAs during the period.

In addition to the domestic production of iron ore, the U.S. imports of iron ore constitute sizeable portions of the total supply. During 1969-76, iron ore imports averaged 42.8 million tons annually (Table 16). This corresponds to approximately 34 percent of the total iron consumed annually in the United States.

D-1. Iron and Steel Scrap

Iron and steel scrap can be classified into two categories: home and purchased scrap. Home scrap consists of by-products,

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1. Iron and steel products include iron ore, pig iron, ferroalloys, bars, rods, plates, sheets, pipe, tube, castings and ferrous scrap.

Table 13. United States: Potential Reserves of Obsolete Iron and Steel Scrap by Census Region, 1975

Census region	Millions of tons
Total	636.2
New England	69.4
Middle Atlantic	42.0
East North Central	99.3
West North Central	121.6
South Atlantic	101.9
East South Central	10.8
West South Central	106.2
Mountain	39.3
Pacific	45.7

Source: Iron and Steel Scrap: Its Accumulation and Availability as of December 31, 1975, prepared for the Metal Scrap Research and Education Foundation by Robert R. Nathan Associates, Inc., August 1977.

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Table 14. Ohio River Basin: Production of Iron Ore, Iron and Steel, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	78,248.8	72,553.8	68,329.2	76,308.1	86,082.8	84,478.6	62,527.3	67,721.4
BEA 48: Chattahooga, TN	1,199.1	1,040.6	978.6	1,183.6	1,253.7	1,270.5	987.9	1,064.4
BEA 49: Nashville, TN	379.5	327.9	304.9	382.0	396.8	417.6	318.8	340.8
BEA 50: Knoxville, TN	385.4	353.7	332.1	378.1	427.0	430.0	315.6	340.0
BEA 52: Huntington, WV	6,032.7	5,801.4	5,799.7	6,161.3	7,052.5	6,635.6	4,819.0	5,438.4
BEA 54: Louisville, KY	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.3
BEA 55: Evansville, IN	582.3	523.1	500.1	601.2	638.4	651.4	484.9	528.7
BEA 62: Cincinnati, OH	6,566.1	6,340.3	6,348.5	6,983.5	7,718.5	7,243.8	5,244.4	5,928.9
BEA 64: Columbus, OH	634.0	587.2	529.7	624.9	626.9	584.0	483.6	503.5
BEA 66: Pittsburgh, PA	47,617.1	43,895.4	40,816.7	45,731.6	51,820.4	51,246.2	38,191.8	40,725.2
BEA 67: Youngstown, OH	14,464.1	13,319.9	12,391.8	13,880.8	15,768.5	15,655.0	11,390.6	12,549.3
BEA 115: Paducah, KY	388.1	364.0	326.8	380.7	379.7	344.1	290.4	301.9

Note: Production figures shown include the production of pig iron, steel mill products, ferroalloys, ferrous castings and ferrous scrap.

a. BEA segments are defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Production of pig iron, steel mill products, ferroalloys, ferrous castings and ferrous scrap are shown annually by BEA segments in Tables A-13 through A-17, respectively.

Table 15. United States: Shipments of Usable Iron Ore from Mines,[a] 1969-76

(Thousands of long tons)

District and state	1969	1970	1971	1972	1973	1974	1975	1976
Total	90,581	87,176	77,106	77,884	90,654	84,985	75,659	76,697
Lake Superior	71,051	68,697	61,710	64,174	75,959	71,924	64,047	64,783
Michigan	14,058	13,100	11,833	12,692	12,389	11,602	14,089	16,245
Minnesota	56,957	54,791	49,054	50,595	62,614	59,422	49,167	47,874
Wisconsin	36	806	824	887	956	899	791	664
Southeastern States	241	1,293	592	449	376	265	1,163	157
Alabama, Georgia, North Carolina	241	1,293	592	449	376	265	1,163	157
Northeastern States	3,404	2,998	2,849	2,346	2,388	2,383	1,924	2,136
New York, Pennsylvania	3,404	2,998	2,849	2,346	2,388	2,383	1,924	2,136
Western States	15,158	14,188	11,955	10,915	12,051	10,552	9,668	9,591
Missouri[b]	---	---	2,727	2,695	2,630	1,866	2,273	2,133
Montana	13	14	14	9	13	30	18	18
Utah	1,921	1,990	1,681	1,788	1,986	1,808	1,334	1,260
Wyoming	2,048	1,949	1,809	2,030	2,070	2,105	2,039	2,139
Other[c]	11,176	10,235	5,726	4,393	5,114	4,465	3,786	4,041

a. Gross weight of ore shipped and exclusive of ores containing 5 percent or more manganese.
b. Included in other for 1969 and 1970.
c. Includes Arizona, Arkansas, California, Colorado, Idaho, Nevada, New Mexico and Texas.
Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1969-76 eds., Vol. I.

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Table 16. United States: Iron Ore Imports for Consumption by Customs Districts, 1969-76.

(Thousands of long tons)

Customs district	1969	1970	1971	1972	1973	1974	1975	1976
United States	40,732	44,891	40,124	35,761	43,296	48,029	46,742	44,390
Baltimore	9,500	10,068	8,452	7,515	9,069	11,880	10,831	9,279
Buffalo	2,479	2,954	2,507	2,085	2,840	4,294	2,759	3,471
Charleston	---	---	---	---	13	70	154	190
Chicago	4,399	5,922	4,596	5,505	5,248	3,999	4,026	6,037
Cleveland	6,620	6,861	6,026	5,153	6,583	4,857	5,556	7,736
Detroit	1,095	1,104	859	954	1,465	1,428	1,899	1,881
Houston	687	844	258	478	1,005	925	690	153
Los Angeles	---	52	101	37	142	134	56	150
Mobile	4,171	4,787	4,762	3,489	4,107	5,776	4,265	4,627
New Orleans	458	602	500	838	524	677	624	809
Ogdensburg	18	4	3	4	4	4	1	---
Philadelphia	11,070	11,419	11,718	9,157	11,951	13,364	15,274	9,597
Portland, Oregon	126	176	114	288	157	270	310	198
San Juan	---	11	---	---	---	5	---	---
Wilmington, North Carolina	---	69	223	257	187	346	296	226
Other[a]	13	2	5	1	1	---	1	36

a. In 1976, Seattle received 34,000 tons of iron ore.
Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1969-76 eds., Vol. I.

waste and discards of the iron- and steel-making processes. This scrap is generated at steel mills and is usually reinserted into steelmaking furnaces. The other category, purchased scrap, consists of waste from industrial manufacturing (referred to as prompt industrial scrap) and obsolete scrap which consists of final steel goods discarded by the end-users.

The area served by the ORS, due to the existence of many steel mills, foundries and fabricating plants, is one of the major iron and steel scrap producing regions in the United States. In 1969, approximately 18.2 million tons of home and purchased scrap were generated from the PSAs. This production reached a high of 19.2 million tons in 1973. In 1976, scrap production in the PSAs was at a level of 15.7 million tons.

The largest iron and steel scrap producing PSA was BEA 66 (Pittsburgh) which in 1976 produced 8.1 million tons, or 52 percent of total scrap production in the PSAs. The next largest producing PSAs were BEA 67 (Youngstown), BEA 62 (Cincinnati) and BEA 52 (Huntington). BEAs 62 and 52, together, accounted for 5.9 million tons in 1976. Iron and steel scrap production by PSA is presented in Appendix Table A-13.

D-2. Ferroalloys

The area served by the ORS is the largest producing region of ferroalloys in the United States. A list of ferroalloys producers in the PSAs is presented in Table 17.

In 1969, ferroalloy production in the PSAs totalled 2.0 million tons. Between 1969 and 1976, production of ferroalloys in the PSAs, following the trend in total U.S. production, declined radically. For example, in 1973, even though this was a record year for steel production in the PSAs and the United States, production of ferroalloys was slightly less than 2.0 million tons in the PSAs. By 1976, ferroalloy production in the PSAs was 1.6 million tons. The largest producing PSA of ferroalloys, between 1969 and 1976, was the BEA 66 (Pittsburgh) which, throughout the period, produced roughly 53 percent of total ORB production (Table A-19).

D-3. Pig Iron

Most of the steel plants in the PSAs are fully integrated facilities. They produce coke from metallurgical coal, blast furnace iron from iron ore, and steel from steelmaking furnaces.

Table 17. Ohio River Basin: Major Producers of Ferroalloys, by BEAs or BEA Segments,[a] 1976

BEA segment/producer	Location	Products[b]
BEA 48: Chattanooga, TN		
Tennessee Metallurgical Corp.	Kimball, TN	FeS
BEA 52: Huntington, WV		
Union Carbide Corp.	Alloy, WV	FeCrSi, FeSi, SiMn
BEA 64: Columbus, OH		
Foote Mineral Co.	Cambridge, OH	FeCrSi, FeSi, FeV
Interlake Inc.	Beverly, OH	FeCr, FeCrSi, FeSi
Ohio Ferro-Alloys Corp.	Philo, OH	FeB, FeMn, FeSi
Union Carbide Corp.	Marietta, OH	FeB, FeSi, FeCr, FeMn
BEA 66: Pittsburgh, PA		
Bethlehem Steel Corp.	Johnstown, PA	FeMn
Molycorp, Inc.	Washington, PA	FeB, FeMo, FeW
Ohio Ferro-Alloys Corp.	Brillant, OH	FeB, FeMn, FeSi, FeV
Ohio Ferro-Alloys Corp.	Powhaton, OH	FeCr, FeB, FeMn, FeSi
United States Steel Corp.	McKeesport, PA	FeMn
BEA 115: Paducah, KY		
Airco Inc.	Calvert City, KY	FeCr, FeCrSi, FeMn, FeSi

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

b. FeB, ferroboron; FeCr, ferrochromium; FeCrSi, gerrochromium-silicon; FeMn, ferromanganese; FeMo, ferromolybdenum; FeSi, ferrosilicon; FeV, ferrovanadium; FeW, ferrotungsten.

Source: U. S. Department of the Interior, Bureau of Mines, "Ferroalloys," Minerals Yearbook, 1976 ed.

There are, however, some companies which produce merchant pig iron for their own foundry purposes (ingot molds primarily) and for sale to other steel mills and foundries.

The production of iron in the PSAs was estimated at 24.1 million tons in 1976. There were four areas which produced pig iron. The largest area was BEA 66 (Pittsburgh) which accounted for 15.3 million tons, or 63 percent of the entire production of pig iron in the PSAs. The production of pig iron fluctuates according to fluctuation in the level of steel production (Table A-15).

D-4. Steel Mill Products

In the PSAs, virtually every shape and form of steel is produced. The area is a large producer of sheets, plates, pipe, tubes, rods, wire, bar, structural shapes and tin mill products.

The production of steel mill products reached a high of 32.8 million tons in 1974 (Table A-16). In that year, BEA 66 produced 20.9 million tons of steel products which represented almost 64 percent of total steel output in the PSAs. Following the decline in total U.S. steel production, the production of steel mill products declined, in 1976, to 25.0 million tons.

A listing of major steel producers in the PSAs is shown in Table 18. The majority of steel plants in the Basin are located in the general area surrounding Pittsburgh (BEA 66).

D-5. Foundry Products

There are five PSAs which manufactured castings between 1969 and 1976. The production of ferrous castings in the PSAs averaged approximately 1.2 million tons during the period (Table A-17). In 1976, there were 1.3 million tons of iron and steel casting produced in the PSAs.

BEAs 66 (Pittsburgh) and 48 (Chattanooga) were the largest producers of castings. They accounted for 945 thousand tons in 1976, or 76 percent of total production in the PSAs.

E. Forecasting Procedures and Assumptions

The domestic production of steel is determined principally by the levels of steel demand in the United States and of steel imports into the country. The procedures and assumptions underlying the projections of ORB Group VIII production are generally the same

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Table 18. Ohio River Basin: Raw Steelmaking Facilities by BEAs and BEA Segments,[a] 1976

BEA and BEA segment and company	Location	Types of furnace
BEA 50: Knoxville, TN		
Knoxville Iron, Div. of Azcon Corp.	Knoxville, TN	Electric
Tennessee Forging Steel Corp.	Harriman, TN	Electric
BEA 52: Huntington, WV		
Armco Steel Corp.	Ashland, KY	Pneumatic
Connors Steel Company	Huntington, WV	Electric
Cyclops Corp., Empire-Detroit Steel Div.[b]	Portsmouth, OH	Open hearth
Kentucky Electric Steel Company	Coalton, KY	Electric
BEA 55: Evansville, IN		
Jessup Steel Co., Green River Steel	Owensboro, KY	Electric
BEA 62: Cincinnati, OH		
American Compressed Steel	Cincinnati, OH	Electric
Armco Steel Corporation	Middletown, OH	Pneumatic, open hearth
Interlake Incorporated	Wilder, KY	Electric
BEA 66: Pittsburgh, PA		
Allegheny Ludlum Steel Corp.	Natrona, PA	Pneumatic
Allegheny Ludlum Steel Corp.	Brackenridge, PA	Electric, pneumatic
Armco Steel Corp.	Butler, PA	Electric
Babcock & Wilcox Company	Beaver Falls, PA	Electric
Bethlehem Steel Corp.	Johnston, PA	Open hearth
Braeburn Steel Alloy Division	Braeburn, PA	Electric
Crucible Inc., Alloy Division	Midland, PA	Pneumatic
Crucible Inc., Stainless Steel Division	Midland, PA	Electric
Cyclops Corp., Universal Cyclops Division	Bridgeville, PA	Electric
Edgewater Corp.	Oakmont, PA	Electric
Jessop Steel Company	Washington, PA	Electric
Jones & Laughlin Steel Corp.[c]	Aliquippa, PA	Pneumatic
Jones & Laughlin Steel Corp.	Pittsburgh, PA	Open hearth, electric
Mesta Machine Company	West Homestead, PA	Open hearth, electric
National Steel Corp.	Weirton, WV	Pneumatic
Union Electric Steel Corp.	Carnegie, PA	Electric
United States Steel Corp.	Braddock, PA	Open hearth
United States Steel Corp.	Munhall, PA	Pneumatic, electric
United States Steel Corp.	Duquesne, PA	Pneumatic, electric
Washington Steel Corp.	Houston, PA	Electric
Wheeling - Pittsburgh Steel Corp.	Monessen, PA	Pneumatic
Wheeling - Pittsburgh Steel Corp.	Steubenville, OH	Pneumatic
Teledyne Vasco	Latrobe, PA	Electric
BEA 67: Youngstown, OH		
Copperweld Corp.	Warren, OH	Electric
Mesta Machine Company	New Castle, PA	Open hearth
Republic Steel Corp.	Warren, OH	Pneumatic
Sharon Steel Corp.	Farrell, PA	Pneumatic, electric
United States Steel Corp.	Youngstown, OH	Open hearth
Youngstown Sheet & Tube Company[d]	Campbell, OH	Open hearth
Youngstown Sheet and Tube Company	Youngstown, OH	Open hearth

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.
b. Plant idle in 1978.
c. Electric furnace in 1979.
d. Plant idle since December 1976.

Source: American Iron and Steel Institute, Directory of Iron and Steel Works of the United States and Canada, 1977. Institute for Iron and Steel Studies, Commentary, January, February 1973. Basic Oxygen Process Association, L-D Process Newsletter, Zurich, Switzerland, June 1977.

as those used in projecting Group VIII consumption (described in Chapter II).

In 1976, annual raw steel capacity in the PSAs was estimated at 49.6 million tons (Table 19). Pneumatic furnaces accounted for roughly 53 percent of the capacity, while open hearth and electric furnaces represented 32 and 15 percent, respectively. It is expected that, throughout the 1980s, open hearth furnaces will be replaced by electric and pneumatic furnaces in the PSAs. By 1990, annual raw steel capacity in the PSAs is expected to reach approximately 47.0 million tons. Pneumatic furnaces will account for 62 percent and electric furnaces will account for 38 percent of the total capacity.

By the year 2000, net additions to raw steel capacity in the PSAs are projected for nearly all of the steel producing PSAs. This growth is expected to be distributed among BEA segments according to the present distribution of raw steel capacity of the region. Capacity increases are expected to occur as plants round out their present steelmaking facilities. The projections recognize that no new integrated steel plants are planned or projected for the PSAs.

F. Probable Future Production Levels

The production of iron ore, steel and iron is projected to increase at an average annual rate of growth of 1.0 percent through 2000 (Table 20). Appendix Tables A-18 through A-22 present projections by type of product. For the period 2000 through 2040, production of Group VIII commodities is projected to increase at a slightly lower average annual rate of 0.9 percent. The major steel producing BEA segments, such as Pittsburgh, Youngstown, Cincinnati and Huntington, are projected to have a slower growth rate than the other, smaller steel producing PSAs.

Table 19. Ohio River Basin: Annual Raw Steel Capacity by BEAs or BEA Segments[a] and Furnace Type, Estimated 1976

(Thousands of tons)

BEA and BEA segment	Total	Pneumatic	Electric	Open hearth
Primary Study Areas	49,636	26,400	7,339	15,897
BEA 50: Knoxville, TN	350	--	350	--
BEA 52: Huntington, WV	3,290	2,000	390	900
BEA 55: Evansville, IN	180	--	180	--
BEA 62: Cincinnati, OH	4,025	2,000	525	1,500
BEA 66: Pittsburgh, PA	30,799	18,300	4,794	7,705
BEA 67: Youngstown, OH	10,992	4,100	1,100	5,792

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: American Iron and Steel Institute, Directory of Iron and Steel Works in the United States and Canada, 1977 ed.; Institute for Iron and Steel Studies, Commentary, Feb. and Mar., 1973; Basic Oxygen Process Association, L-D Process Newsletter, Zurich, Switzerland, June 1977.

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Table 20. Ohio River Basin: Production of Iron Ore, Iron and Steel Products, by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	67,721.4	75,252.9	76,461.9	84,765.1	107,434.2	123,200.6	1.0	0.9
BEA 48: Chattanooga, TN	1,064.4	1,245.2	1,868.5	2,192.7	3,015.8	3,537.0	3.1	1.2
BEA 49: Nashville, TN	340.8	397.4	643.8	743.7	1,006.1	1,171.1	3.3	1.1
BEA 50: Knoxville, TN	340.0	393.2	492.6	575.5	779.4	907.7	2.2	1.1
BEA 52: Huntington, WV	5,438.4	6,555.6	7,748.7	8,978.6	12,035.4	13,968.7	2.1	1.1
BEA 54: Louisville, KY	0.3	0.3	0.5	0.6	0.8	0.9	2.9	1.0
BEA 55: Evansville, IN	528.7	618.6	952.1	1,115.7	1,532.5	1,798.1	3.2	1.2
BEA 62: Cincinnati, OH	5,928.9	6,999.0	7,239.2	8,149.6	10,644.4	12,170.7	1.3	1.0
BEA 64: Columbus, OH	503.5	555.3	682.1	806.7	1,149.8	1,374.3	2.0	1.3
BEA 66: Pittsburgh, PA	40 725.2	46,202.5	44,405.8	47,947.5	58,188.0	66,223.5	0.7	0.8
BEA 67: Youngstown, OH	12,549.3	11,912.9	11,868.7	13,583.8	18,053.6	20,773.7	0.4	1.1
BEA115: Paducah, KY	301.9	372.9	519.9	670.7	1,028.4	1,274.9	3.4	1.6

Note: Production of iron ore, iron and steel products were projected for 1980-2040 on an individual commodity basis. Production totals shown include pig iron production from Table A-18, steel production from Table A-19, iron and steel scrap production from Table A-22, ferroalloy production from Table A-20, and foundry production from Table A-21.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Production of the iron ore, iron and steel commodity group shown in Tables A-18 through A-22.

IV. TRANSPORTATION CHARACTERISTICS

Iron ore, steel and iron products are generally transported by rail and truck from one of a few producing areas to destinations throughout the United States. In past decades, in order to reduce the requirements for long-haul transport, there has been a general trend towards producing steel closer to steel market areas.

A. Existing and Historical Modal Split

Commodities and products in the iron ore, steel and iron group are shipped by rail, truck and barge modes of transport. In the United States in 1972, approximately 51 percent of steel mill products were transported by truck; 43.7 percent, by rail, and; 5.5 percent, by water.[1] For the Pittsburgh region, due to the accessibility of navigable waterways and existing rail lines, the modal split varied slightly. The 1972 modal split for transporting steel mill products from BEA 66 (Pittsburgh) was: 47 percent by rail, 43 percent by truck, and 10 percent, water.

For the area served by the ORS, the modal split between rail, truck and water is shown in Table 21. The table presents net movements of iron ore, steel and iron commodities by each of those modes of shipment. In 1976, net waterway shipments of Group VIII commodities totalled 542 thousand tons inbound to the ORS. Rail,

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1. U.S. Department of Commerce, Bureau of the Census, Census of Transportation, 1972 ed. (Washington, D.C.: GPO, 1976) Vol. III. It should be noted that this modal split is solely for steel mill products and does not include the other commodities contained in this study group. However, it is felt that, with the exception of iron ore, they reflect the distribution among the competing modes for transporting these commodities.

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Table 21. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Iron Ore, Iron and Steel, by BEAs or BEA Segments,[a] Estimated 1976

(Thousands of tons)

BEA and BEA segment	Production	Consumption	Shipments (receipts)						
				Water					
			Total net	Net	Inbound	Outbound	Local	Net rail	Net truck
Primary Study Areas	67,721.4	89,416.1	(21,694.7)	(542.7)	2,044.3[b]	1,501.6[b]	1,518.0[b]	(24,136.5)	2,984.5
BEA 47: Huntsville, AL	--	43.1	(43.1)	(170.5)	235.1	64.6	--	(205.4)	332.8
BEA 48: Chattanooga, TN	1,064.4	936.7	127.7	(88.8)	107.2	18.4	--	(126.8)	343.3
BEA 49: Nashville, TN	340.8	532.8	(192.0)	(260.5)	318.8	58.3	--	(80.9)	149.4
BEA 50: Knoxville, TN	340.0	439.4	(99.4)	15.6	1.1	16.7	--	47.4	(162.4)
BEA 52: Huntington, WV	5,438.4	6,457.8	(1,019.4)	163.0	8.2	171.2	1.0	(2,746.2)	1,563.8
BEA 54: Louisville, KY	0.3	1,064.2	(1,063.9)	(261.8)	347.9	86.1	--	46.4	(848.5)
BEA 55: Evansville, IN	528.7	536.4	(7.7)	(38.2)	95.8	57.6	--	(31.8)	62.3
BEA 62: Cincinnati, OH	5,928.9	8,744.5	(2,815.6)	(596.7)	658.8	62.1	--	(1,617.0)	(601.9)
BEA 64: Columbus, OH	503.5	133.1	370.4	4.7	50.3	55.0	--	18.8	346.9
BEA 66: Pittsburgh, PA	40,725.2	53,704.5	(12,979.3)	999.8	885.5	1,885.3	420.2	(17,308.0)	3,328.9
BEA 67: Youngstown, OH[c]	12,549.3	16,823.6	(4 274.3)	(339.5)	361.4	21.9	--	(2,218.8)	(1,716.0)
BEA 115: Paducah, KY	301.9	--	301.9	30.2	71.9	101.2	--	85.8	185.9

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

b. Primary Study Area shipments equal inbound, outbound and local shipments to the PSAs as a unit and do not equal the sum of shipments reported for each of the BEA segments.

c. Includes waterway shipments shipped from/to BEA 67 via BEA 68.

Source: Production and consumption from Tables 20 and 6. Water and rail shipments compiled by RRNA from Waterborne Commerce by Port Equivalents, revised 1976, and ICC Railroad Waybill Sample, 1976, supplied by the U.S. Army Corps of Engineers.

which carried the bulk of iron ore transported from the Great Lake ports into the area, had a net movement of 24.1 million tons inbound to the ORS. Net truck accounted for 3.0 million tons moving outbound from the ORS. The truck shipments consisted primarily of finished steel mill products which were destined for many areas throughout the country.

B. Intermodal Characteristics

There are relatively few intermodal transfers of Group VIII products. Nearly every steel plant which either ships or receives commodities on the Ohio River System is located adjacent to the waterway. There are, however, two inland steel plants which also use (or will use) the waterway.

One inland plant, located in Mahoning County, Ohio, rails oil country pipe and tube products to Aliquippa, Pennsylvania. Shipments are then transferred to barge for lower-Mississippi and Gulf Coast destinations. The other inland plant, to be located in Johnstown, Pennsylvania, will be expected to receive iron and steel scrap by rail after it is barged into the Pittsburgh area. This will be a new movement of scrap on the waterway which will fulfill the scrap requirements of a 2 million ton electric furnace to be installed in Johnstown around 1985.

There are also instances of iron and steel products being transshipped by truck to inland destinations after being initially shipped by barge to a port terminal or warehouse. These transshipments usually are consumed in the same BEA or BEA segment as the port and were treated as such for consumption purposes.

C. Factors Affecting Modal Choice

There are many factors which influence a steel company's decision about the mode of transport it will choose to ship and receive goods. The factors affecting modal choice which have been identified by this study are as follows:[1]

(1) The proximity of origins and destinations of iron

(2) The reliability and speed of delivery

(3) The tonnage requirements to make barge shipments feasible, as compared to truck or rail.

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1. In accordance with procedures outlined by the U.S. Army Corps of Engineers, future changes in the relative costs of the various modes of transport were not addressed by this study.

As stated above, most of the steel plants in the PSAs are located adjacent to the waterway and have opportunities to ship by water. Yet, the percentage of iron ore, steel and iron commodities that is transported via the waterway is small (at best, 10 percent of all movements).

The reason for this limited use of the waterway, which is most often cited by industry officials, is the high inventory cost associated with waterway shipments. Since barge shipments generally require three to four times as long in transit as other modes, a floating inventory cost is borne by the steel shipper. Because of low profits and lack of capital in the steel industry, there has been a divergence away from barge to quicker modes of transportation.

Another factor exerting a negative influence on waterway shipments is the large tonnage required to make barge shipments feasible, as compared to shipping by truck or rail. In many instances, the quantity of iron and steel products to be shipped to an individual destination is not large enough to make shipment by barge practical and these smaller quantities tend to move inland via truck.

D. Forecasting Procedures and Assumptions

Generally, the projections of iron and steel product movements in the PSAs assume that the future origin and destination links, and the future modal split, will conform to the links and transportation patterns existing in 1976. This assumption is based on the belief that the factors underlying modal choice outlined in the previous section will continue to be the dominant factors affecting modal split during the forecast period. Deviations from the 1976 pattern were projected only when specific changes were anticipated or reported during discussions with industry official and major shippers.

One such deviation was an anticipated increase in the shipment of iron and steel scrap via the ORS. The increase is expected due to the installation of large electric furnaces by two producers in the Pittsburgh area.[1] These producers reported that they expect to

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1. One producer started its electric furnaces in June 1979, while the other is expected to start production in the mid-1980.

receive roughly 30 percent of their new scrap requirements via the waterway. They also expect to receive the scrap from manufacturing areas located along the waterway in the PSAs and the SPAs.

In developing the projected modal split between water, rail and truck, base projections for waterway shipments were developed from the projections of iron and steel production and consumption of individual PSAs. The methodology employed linked inbound waterway movements to the level of consumption in a particular PSA, whereas outbound waterway movements were associated with the PSA's production level.[1] For local waterway movements within a PSA, the combined level of production and consumption in that PSA was utilized as a proxy for the level of iron and steel activity. The methodology outlined above was necessary due to the diverse characteristics of the many commodities in this group.

The base forecast was then adjusted to account for specific information received from industry officials and major waterway shippers. This procedure of establishing a base forecast with subsequent adjustment was undertaken for each of the forecast periods.

For the increased scrap originating in the PSAs, waterway shipments were allocated based upon the 1976 distribution of total iron and steel movements. This method of allocation was chosen because it considered the level of steel activity in the PSAs as well as the capability to ship steel material via the waterway. For scrap originating in the SPAs, earnings for fabricated metal products, machinery, and electrical machinery were used to allocate scrap shipments. These three industries traditionally generate much of the Nation's supply of prompt industrial scrap and often locate along the waterway.

The above adjustments for increased scrap shipments were incorporated into the projections for 1980 and 1990. Subsequent projections were made utilizing this scrap adjusted base with no additional deviations identified.

The net rail and net truck movements were calculated after the projection of the net waterway movements. In projecting net rail shipments for each PSA, it was assumed that the relationship between net rail shipments and the residual of total net minus net water would be maintained throughout the forecast period.

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1. For more detail on the methodology used for projecting waterway movements, see footnote to Table 22.

Similarly, net truck movements of iron and steel products were projected as the residual of net waterway and rail shipments from total net shipments. The projections for truck and rail were substantiated by estimates provided by industry officials obtained during our field interviews. In many instances, producers were able to furnish data concerning their own shipments, and often they were able to provide the modal split for these shipments.

E. Probable Future Modal Split

Table 22 presents the projected net shipments of iron ore, steel and iron for the period 1976-2040. In 1976, there were 3.0 million tons of net truck shipments moving outbound from the PSAs. Many of these outbound shipments were specific steel products which will continue to be shipped by truck in the future. A significant increase in inbound shipments to the PSAs of iron and steel products is also projected, however. This will have the effect of reducing the net truck outbound shipments of Group VIII commodities to 1.8 million tons by 2000. This trend, caused by the consumption of iron and steel commodities growing at a quicker rate than the production of those goods in the region, is expected to continue through the forecast period. By 2020, a net truck inbound shipment of iron and steel commodities of 1.5 million tons is projected.

F. Probable Future Waterway Traffic Flows

BEA-to-BEA waterborne traffic projections are presented in Table 23. Growth indices for BEA links are shown in Table 24.

Gross waterborne shipments of iron ore, steel and iron commodities in the ORS are expected to increase at an average annual rate of 2.6 percent between 1976 and 2000. After 2000, the growth will be more gradual. It will increase at an average rate of 1.7 percent annually.

Outbound waterway shipments from the PSAs are expected to increase at a slower rate than inbound shipments. This is due to the relatively large growth in consumption of iron and steel commodities as compared to the growth of iron and steel production in the PSAs. Thus, the current level of inbound shipments of iron and steel goods to the ORS is expected to be accentuated in future years. Inbound shipments of iron ore, steel and iron commodities are projected to grow at an average annual rate of 3.8 percent through 2000 and at 2.1 percent thereafter.

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Table 22. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Iron Ore, Steel and Iron, Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

	Estimated 1976	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1976-2000	2000-2040
Production	67,721.4	75,252.9	76,421.9	84,765.1	107,434.2	123,200.6	0.9	0.9
Consumption	89,416.1	100,662.6	101,286.0	116,005.2	155,314.8	183,544.2	1.1	1.2
Net shipments (receipts)	(21,694.7)	(25,409.7)	(24,864.1)	(31,240.1)	(47,880.6)	(60,343.6)	1.5	1.6
Net waterborne	(542.7)	(987.3)	(1,774.6)	(2,807.7)	(5,708.6)	(8,060.9)	7.1	2.7
Net rail	(24,136.5)	(27,603.9)	(25,805.4)	(30,210.5)	(40,644.3)	(47,413.5)	0.9	1.1
Net truck	2,984.5	3,181.5	2,715.9	1,778.1	(1,527.7)	(4,869.2)	(2.1)	a
Gross waterborne shipments:								
Outbound	1,501.6	1,782.1	1,934.0	2,171.4	2,818.0	3,294.1	1.6	1.1
Inbound	2,044.3	2,769.4	3,708.6	4,979.1	8,526.6	11,355.0	3.8	2.1
Local	1,518.0	1,813.4	2,022.1	2,285.4	2,979.4	3,474.8	1.7	1.1
Total	5,063.9	6,364.9	7,664.7	9,435.9	14,324.0	18,123.9	2.6	1.7

Note: Net shipments (receipts) equal to production minus consumption. Net waterway shipments were based on the projections of outbound and inbound shipments of the individual BEAs or BEA segments. Outbound waterway shipments in each BEA or BEA segment were based on the growth rates of production in each BEA. Inbound waterway shipments were projected by BEA or BEA segment based upon the growth of consumption in the individual BEAs. Local shipments were projected based upon the growth of the sum of production and consumption, which was used as a proxy of the activity level. Net inbound waterway movements for the Ohio River System were projected based on the projected waterway receipts of ORB BEAs or BEA segments and the historical proportions of those receipts which entered the ORS. Net outbound waterway movements were projected based upon the projected waterway shipments of ORB BEA and BEA segments and the historical proportion that those BEAs or BEA segments shipped to areas outside the ORS. Net truck and net rail shipments by BEA and BEA segment were assumed to have the same relationship to one another that existed in 1976.

a. Not defined.

Source: Tables 8, 20 and 21; Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

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Table 23. Ohio River System: BEA-to-BEA Waterborne Traffic of Iron Ore, Steel and Iron, Actual 1976 and Projected 1980-2040, Selected Years

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS					
			1976	1980	1990	2000	2020	2040
038	052	08	11	13	16	20	32	39
038	054	08	10	13	22	31	56	77
046	049	08	22	36	74	115	216	303
046	066	08	111	212	340	435	709	925
046	068	08	82	108	123	135	174	200
047	064	08	20	21	33	51	105	148
047	066	08	202	342	632	990	1942	2791
047	068	08	50	29	40	54	89	111
047	077	08	88	125	249	356	643	868
047	078	08	11	15	22	33	60	79
047	089	08	33	46	75	111	212	293
047	091	08	133	182	223	294	480	619
047	114	08	33	46	76	122	334	464
047	117	08	44	55	60	71	104	122
047	137	08	11	17	22	27	42	52
047	141	08	10	15	29	48	103	148
047	144	08	11	13	14	19	34	45
048	066	08	96	155	298	357	507	602
048	068	08	21	9	13	13	15	16
048	077	08	11	15	25	28	36	40
048	144	08	56	67	70	78	97	111
049	066	08	174	239	585	680	936	1103
049	077	08	31	41	97	104	127	141
049	078	08	102	132	177	204	268	307
049	114	08	225	302	445	520	713	829
049	138	08	11	16	36	43	62	73
049	144	08	40	48	56	62	76	86
050	066	08	0	10	43	66	118	151
050	077	08	167	187	209	228	281	313
052	046	08	30	36	47	55	79	94
052	047	08	30	31	92	145	254	333
052	052	08	10	12	12	14	19	21
052	054	08	0	0	100	155	281	362
052	055	08	30	36	57	80	139	181
052	062	08	110	135	135	140	156	169
052	066	08	446	577	565	583	647	693
052	068	08	10	12	11	12	13	12
052	077	08	133	163	169	183	228	255
052	078	08	41	50	54	62	82	95
052	079	08	10	12	15	17	23	27
052	091	08	60	73	79	83	96	103
052	103	08	10	12	15	17	23	27
052	111	08	60	73	86	100	135	157

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Table 23. (Continued)

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS					
			1976	1980	1990	2000	2020	2040
052	114	08	121	149	170	198	269	313
052	115	08	191	227	295	342	435	480
052	117	08	10	11	12	12	12	12
052	118	08	50	63	66	76	103	119
052	135	08	100	117	138	159	214	249
052	138	08	60	78	104	125	277	335
052	141	08	210	265	342	413	498	586
054	046	08	50	57	109	134	187	214
054	062	08	11	13	20	21	24	27
054	066	08	642	729	1349	1630	2089	2361
054	077	08	85	95	151	171	207	222
054	114	08	21	23	40	49	66	73
054	137	08	21	16	24	24	26	26
054	141	08	31	36	69	85	220	249
055	062	08	22	27	37	40	46	49
055	066	08	377	474	767	905	1088	1273
055	077	08	33	39	55	60	75	85
055	114	08	22	26	40	47	64	76
055	115	08	11	12	20	23	29	33
055	138	08	67	82	143	169	342	411
055	141	08	33	40	69	83	180	214
055	144	08	11	12	12	12	16	18
062	046	08	11	16	21	23	31	36
062	054	08	0	0	100	154	287	367
062	066	08	556	811	873	934	1060	1173
062	077	08	22	31	32	33	39	42
062	141	08	32	47	60	79	180	208
064	047	08	100	108	180	237	387	488
064	052	08	20	21	21	23	31	34
064	054	08	21	27	69	71	82	90
064	055	08	20	23	43	65	125	168
064	066	08	11	20	23	30	40	45
064	068	08	40	60	57	59	68	72
064	077	08	244	265	275	306	396	456
064	091	08	11	13	15	16	19	21
064	114	08	73	83	102	122	175	207
064	138	08	10	11	17	20	29	35
066	039	08	11	13	13	14	17	20
066	046	08	905	1070	1103	1225	1565	1832
066	047	08	527	533	661	849	1957	2352
066	048	08	425	444	478	549	703	806
066	049	08	617	720	861	1174	1546	1798
066	052	08	10	12	11	15	33	37
066	054	08	2747	3445	3744	4214	4329	4862
066	055	08	686	805	989	1275	1940	2414
066	062	08	1763	1927	1918	1795	2237	2287
066	064	08	130	135	129	153	188	203
066	066	08	4202	4887	3462	3038	3164	3311
066	077	08	689	802	630	638	685	751
066	078	08	211	234	218	227	270	313

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Table 23. (Continued)

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS 1976	1980	1990	2000	2020	2040
066	091	08	281	308	312	314	323	330
066	107	08	11	13	13	14	17	20
066	111	08	43	52	53	57	70	79
066	114	08	1560	1810	1783	1925	2250	2565
066	115	08	53	56	57	57	66	75
066	117	08	22	24	26	27	27	34
066	118	08	448	521	522	565	688	784
066	119	08	342	398	392	424	515	587
066	133	08	11	13	13	14	17	20
066	134	08	32	38	37	40	49	55
066	135	08	81	101	104	114	139	159
066	137	08	20	28	21	24	29	36
066	138	08	3488	4119	4336	4820	5794	6700
066	140	08	171	199	196	212	258	293
066	141	08	3489	4103	4305	4759	5816	6776
066	915	08	80	94	93	100	122	139
068	046	08	22	30	38	45	64	76
068	047	08	32	33	44	57	66	84
068	054	08	10	14	24	29	35	40
068	066	08	22	34	28	28	39	46
068	077	08	22	27	27	29	34	37
068	078	08	22	27	27	31	40	45
068	141	08	89	117	154	172	242	271
077	047	08	1355	1890	2686	4011	6873	8985
077	048	08	312	495	779	972	1679	2242
077	049	08	790	1157	1552	1600	2188	2564
077	054	08	241	427	961	992	1514	1993
077	055	08	189	303	574	894	1827	2603
077	062	08	33	54	59	66	87	108
077	064	08	33	38	58	87	150	205
077	066	08	41	457	483	562	567	722
077	115	08	91	137	222	284	437	548
078	047	08	11	15	26	40	81	117
078	049	08	22	37	69	102	183	251
078	062	08	11	17	22	25	34	40
078	066	08	267	447	664	830	1297	1663
079	047	08	56	88	202	282	488	667
079	066	08	100	208	255	259	287	290
091	066	08	21	53	86	93	115	131
111	047	08	11	53	130	164	248	321
111	066	08	0	100	208	212	236	246
113	048	08	45	64	117	149	230	292
113	066	08	0	30	45	47	54	61
114	047	08	22	38	70	103	194	267
114	049	08	45	90	179	252	432	583
114	066	08	145	304	457	513	701	844
114	115	08	21	40	71	87	125	151
115	047	08	64	68	152	281	597	860
115	066	08	321	482	782	887	1166	1434

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Table 23. (Continued)

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS 1976	1980	1990	2000	2020	2040
115	068	08	350	379	411	579	716	786
115	077	08	140	187	236	286	398	472
115	078	08	11	14	17	22	32	40
115	114	08	11	14	19	24	37	45
115	138	08	93	121	192	252	551	696
115	141	08	22	28	44	59	168	211
117	066	08	21	60	103	112	138	157
118	066	08	21	43	64	70	87	98
119	066	08	11	80	164	179	220	251
134	066	08	44	64	77	85	104	119
135	066	08	54	97	135	147	181	207
137	049	08	33	40	94	181	434	618
137	055	08	11	14	23	38	84	124
137	062	08	267	327	361	450	674	825
137	066	08	44	70	116	161	298	455
137	068	08	50	59	56	66	93	111
138	047	08	122	132	291	520	1612	3184
138	048	08	290	344	472	797	1486	2007
138	049	08	1659	2155	4078	7072	15676	23025
138	050	08	11	13	17	22	36	46
138	052	08	31	36	40	50	57	78
138	054	08	450	618	2189	5179	14423	21581
138	055	08	22	25	32	41	78	90
138	062	08	4371	5346	5525	7002	10215	12610
138	064	08	275	277	338	514	990	1344
138	066	08	5118	7431	8521	9192	10558	11183
138	068	08	2970	2786	2640	3026	4271	5079
138	115	08	343	405	558	785	1327	1712
140	066	08	10	24	39	42	52	60
141	052	08	10	30	41	45	57	62
141	064	08	45	143	282	340	488	592
141	066	08	0	71	169	173	191	212
144	068	08	30	31	33	38	53	61
915	047	08	21	27	48	68	124	169
915	068	08	11	22	30	34	45	52
		TOTAL	50639	63649	76647	94359	143240	181239

Note: BEA 915 refers to counties of BEA 115 which are origins and destinations of waterborne movements shipped to and from points on the Mississippi River.

Source: Robert R. Nathan Associates, Inc.

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Table 24. Ohio River System: Growth Rates of Iron Ore, Steel and Iron Waterborne Commerce, BEA to BEA Projected 1976-2040, Selected Years

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
038052	08	11	1000	1182	1455	1818	2909	3545
038054	08	10	1000	1300	2200	3100	5600	7700
046049	08	22	1000	1636	3364	5227	9818	13773
046066	08	111	1000	1910	3063	3919	6387	8333
046068	08	82	1000	1317	1500	1646	2122	2439
047064	08	20	1000	1050	1650	2550	5250	7400
047066	08	202	1000	1693	3129	4901	9614	13817
047068	08	50	1000	580	800	1080	1780	2220
047077	08	88	1000	1420	2830	4045	7307	9864
047078	08	11	1000	1364	2000	3000	5455	7182
047089	08	33	1000	1394	2273	3364	6424	8879
047091	08	133	1000	1368	1677	2211	3609	4654
047114	08	33	1000	1394	2303	3697	10121	14061
047117	08	44	1000	1250	1364	1614	2364	2773
047137	08	11	1000	1545	2000	2455	3818	4727
047141	08	10	1000	1500	2900	4800	10300	14800
047144	08	11	1000	1182	1273	1727	3091	4091
048066	08	96	1000	1615	3104	3719	5281	6271
048068	08	21	1000	429	619	619	714	762
048077	08	11	1000	1364	2273	2545	3273	3636
048144	08	56	1000	1196	1250	1393	1732	1982
049066	08	174	1000	1374	3362	3908	5379	6339
049077	08	31	1000	1323	3129	3355	4097	4548
049078	08	102	1000	1294	1735	2000	2627	3010
049114	08	225	1000	1342	1978	2311	3169	3684
049138	08	11	1000	1455	3273	3909	5636	6636
049144	08	40	1000	1200	1400	1550	1900	2150
050066	08	10	0	1000	4300	6600	11800	15100
050077	08	167	1000	1120	1251	1365	1683	1874
052046	08	30	1000	1200	1567	1833	2633	3133
052047	08	30	1000	1033	3067	4833	8467	11100
052052	08	10	1000	1200	1200	1400	1900	2100
052054	08	100	0	0	1000	1550	2810	3620
052055	08	30	1000	1200	1900	2667	4633	6033
052062	08	110	1000	1227	1227	1273	1418	1536
052066	08	446	1000	1294	1267	1307	1451	1554
052068	08	10	1000	1200	1100	1200	1300	1200
052077	08	133	1000	1226	1271	1376	1714	1917
052078	08	41	1000	1220	1317	1512	2000	2317
052079	08	10	1000	1200	1500	1700	2300	2700
052091	08	60	1000	1217	1317	1383	1600	1717
052103	08	10	1000	1200	1500	1700	2300	2700
052111	08	60	1000	1217	1433	1667	2250	2617

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Table 24. (Continued)

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
052114	08	121	1000	1231	1405	1636	2223	2587
052115	08	191	1000	1188	1545	1791	2277	2513
052117	08	10	1000	1100	1200	1200	1200	1200
052118	08	50	1000	1260	1320	1520	2060	2380
052135	08	100	1000	1170	1380	1590	2140	2490
052138	08	60	1000	1300	1733	2083	4617	5583
052141	08	210	1000	1262	1629	1967	2371	2790
054046	08	50	1000	1140	2180	2680	3740	4280
054062	08	11	1000	1182	1818	1909	2182	2455
054066	08	642	1000	1136	2101	2539	3254	3678
054077	08	85	1000	1118	1776	2012	2435	2612
054114	08	21	1000	1095	1905	2333	3143	3476
054137	08	21	1000	762	1143	1143	1238	1238
054141	08	31	1000	1161	2226	2742	7097	8032
055062	08	22	1000	1227	1682	1818	2091	2227
055066	08	377	1000	1257	2034	2401	2886	3377
055077	08	33	1000	1182	1667	1818	2273	2576
055114	08	22	1000	1182	1818	2136	2909	3455
055115	08	11	1000	1091	1818	2091	2636	3000
055138	08	67	1000	1224	2134	2522	5104	6134
055141	08	33	1000	1212	2091	2515	5455	6485
055144	08	11	1000	1091	1091	1091	1455	1636
062046	08	11	1000	1455	1909	2091	2818	3273
062054	08	100	0	0	1000	1540	2870	3670
062066	08	556	1000	1459	1570	1680	1906	2110
062077	08	22	1000	1409	1455	1500	1773	1909
062141	08	32	1000	1469	1875	2469	5625	6500
064047	08	100	1000	1080	1800	2370	3870	4880
064052	08	20	1000	1050	1050	1150	1550	1700
064054	08	21	1000	1286	3286	3381	3905	4286
064055	08	20	1000	1150	2150	3250	6250	8400
064066	08	11	1000	1818	2091	2727	3636	4091
064068	08	40	1000	1500	1425	1475	1700	1800
064077	08	244	1000	1086	1127	1254	1623	1869
064091	08	11	1000	1182	1364	1455	1727	1909
064114	08	73	1000	1137	1397	1671	2397	2836
064138	08	10	1000	1100	1700	2000	2900	3500
066039	08	11	1000	1182	1182	1273	1545	1818
066046	08	905	1000	1182	1219	1354	1729	2024
066047	08	527	1000	1011	1254	1611	3713	4463
066048	08	425	1000	1045	1125	1292	1654	1896
066049	08	617	1000	1167	1395	1903	2506	2914
066052	08	10	1000	1200	1100	1500	3300	3700
066054	08	2747	1000	1254	1363	1534	1576	1770
066055	08	686	1000	1173	1442	1859	2828	3519
066062	08	1763	1000	1093	1088	1018	1269	1297
066064	08	130	1000	1038	992	1177	1446	1562
066066	08	4202	1000	1163	824	723	753	788

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Table 24. (Continued)

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
066077	08	689	1000	1164	914	926	994	1090
066078	08	211	1000	1109	1033	1076	1280	1483
066091	08	281	1000	1096	1110	1117	1149	1174
066107	08	11	1000	1182	1182	1273	1545	1818
066111	08	43	1000	1209	1233	1326	1628	1837
066114	08	1560	1000	1160	1143	1234	1442	1644
066115	08	53	1000	1057	1075	1075	1245	1415
066117	08	22	1000	1091	1182	1227	1227	1545
066118	08	448	1000	1163	1165	1261	1536	1750
066119	08	342	1000	1164	1146	1240	1506	1716
066133	08	11	1000	1182	1182	1273	1545	1818
066134	08	32	1000	1188	1156	1250	1531	1719
066135	08	81	1000	1247	1284	1407	1716	1963
066137	08	20	1000	1400	1050	1200	1450	1800
066138	08	3488	1000	1181	1243	1382	1661	1921
066140	08	171	1000	1164	1146	1240	1509	1713
066141	08	3489	1000	1176	1234	1364	1667	1942
066915[d]	08	80	1000	1175	1163	1250	1525	1738
068046	08	22	1000	1364	1727	2045	2909	3455
068047	08	32	1000	1031	1375	1781	2063	2625
068054	08	10	1000	1400	2400	2900	3500	4000
068066	08	22	1000	1545	1273	1273	1773	2091
068077	08	22	1000	1227	1227	1318	1545	1682
068078	08	22	1000	1227	1227	1409	1818	2045
068141	08	89	1000	1315	1730	1933	2719	3045
077047	08	1355	1000	1395	1982	2960	5072	6631
077048	08	312	1000	1587	2497	3115	5381	7186
077049	08	790	1000	1465	1965	2025	2770	3246
077054	08	241	1000	1772	3988	4116	6282	8270
077055	08	189	1000	1603	3037	4730	9667	13772
077062	08	33	1000	1636	1788	2000	2636	3273
077064	08	33	1000	1152	1758	2636	4545	6212
077066	08	41	1000	11146	11780	13707	13829	17610
077115	08	91	1000	1505	2440	3121	4802	6022
078047	08	11	1000	1364	2364	3636	7364	10636
078049	08	22	1000	1682	3136	4636	8318	11409
078062	08	11	1000	1545	2000	2273	3091	3636
078066	08	267	1000	1674	2487	3109	4858	6228
079047	08	56	1000	1571	3607	5036	8714	11911
079066	08	100	1000	2080	2550	2590	2870	2900
091066	08	21	1000	2524	4095	4429	5476	6238
111047	08	11	1000	4818	11818	14909	22545	29182
111066	08	100	0	1000	2080	2120	2360	2460
113048	08	45	1000	1422	2600	3311	5111	6489
113066	08	30	0	1000	1500	1567	1800	2033
114047	08	22	1000	1727	3182	4682	8818	12136
114049	08	45	1000	2000	3978	5600	9600	12956
114066	08	145	1000	2097	3152	3538	4834	5821

(Continued)

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Table 24. (Continued)

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
114115	08	21	1000	1905	3381	4143	5952	7190
115047	08	64	1000	1063	2375	4391	9328	13438
115066	08	321	1000	1502	2436	2763	3632	4467
115068	08	350	1000	1083	1174	1654	2046	2246
115077	08	140	1000	1336	1686	2043	2843	3371
115078	08	11	1000	1273	1545	2000	2909	3636
115114	08	11	1000	1273	1727	2182	3364	4091
115138	08	93	1000	1301	2065	2710	5925	7484
115141	08	22	1000	1273	2000	2682	7636	9591
117066	08	21	1000	2857	4905	5333	6571	7476
118066	08	21	1000	2048	3048	3333	4143	4667
119066	08	11	1000	7273	14909	16273	20000	22818
134066	08	44	1000	1455	1750	1932	2364	2705
135066	08	54	1000	1796	2500	2722	3352	3833
137049	08	33	1000	1212	2848	5485	13152	18727
137055	08	11	1000	1273	2091	3455	7636	11273
137062	08	267	1000	1225	1352	1685	2524	3090
137066	08	44	1000	1591	2636	3659	6773	10341
137068	08	50	1000	1180	1120	1320	1860	2220
138047	08	122	1000	1082	2385	4262	13213	26098
138048	08	290	1000	1186	1628	2748	5124	6921
138049	08	1659	1000	1299	2458	4263	9449	13879
138050	08	11	1000	1182	1545	2000	3273	4182
138052	08	31	1000	1161	1290	1613	1839	2516
138054	08	450	1000	1373	4864	11509	32051	47958
138055	08	22	1000	1136	1455	1864	3545	4091
138062	08	4371	1000	1223	1264	1602	2337	2885
138064	08	275	1000	1007	1229	1869	3600	4887
138066	08	5118	1000	1452	1665	1796	2063	2185
138068	08	2970	1000	938	889	1019	1438	1710
138115	08	343	1000	1181	1627	2289	3869	4991
140066	08	10	1000	2400	3900	4200	5200	6000
141052	08	10	1000	3000	4100	4500	5700	6200
141064	08	45	1000	3178	6267	7556	10844	13156
141066	08	71	0	1000	2380	2437	2690	2986
144068	08	30	1000	1033	1100	1267	1767	2033
915047[d]	08	21	1000	1286	2286	3238	5905	8048
915068[d]	08	11	1000	2000	2727	3091	4091	4727

a. The first three digits indicate the BEA of origin; the last three digits indicate the BEA of destination.

b. Hundreds of tons.

c. Growth rates are reported such that 1000 equals the index value reported in the third column.

d. BEA 915 refers to counties of BEA 115 which are origins and destinations of waterborne movements which are shipped from and to points on the Mississippi River.

Source: Robert R. Nathan Associates, Inc.

Local waterborne shipments of Group VIII commodities are projected to increase at an average annual rate of 1.3 percent between 1976 and 2040. This growth reflects the varying growth rates of individual PSAs. For instance, more local ORB waterborne shipments will be needed to satisfy consumption growth in PSAs which have relatively little steel production.

V. APPENDIX A

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Table A-1. Ohio River Basin: Consumption of Iron Ore and Concentrates, by BEAs or BEA Segments[a] and Furnace Type, Estimated 1969-76

(Thousands of tons)

BEA and BEA segment and furnace type	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	43,061.3	40,441.8	36,243.8	40,581.6	45,711.7	44,218.8	33,301.9	35,487.3
Blast furnace	42,003.4	39,592.4	35,639.6	39,991.2	45,034.3	43,561.5	33,009.9	35,164.8
Steel furnace	1,057.9	848.4	604.2	590.4	677.4	657.3	292.0	322.5
BEA 50: Knoxville, TN	7.6	6.1	4.3	4.2	4.8	4.7	2.1	2.3
Blast furnace	--	--	--	--	--	--	--	--
Steel furnace	7.6	6.1	4.3	4.2	4.8	4.7	2.1	2.3
BEA 52: Huntington, W.V.	3,678.0	3,528.7	3,473.6	3,498.6	4,201.9	3,847.3	2,847.4	3,181.2
Blast furnace	3,606.8	3,468.8	3,427.8	3,454.6	4,152.8	3,802.3	2,827.8	3,158.5
Steel furnace	71.2	59.9	45.8	44.0	49.1	45.0	19.6	22.7
BEA 55: Evansville, IN	3.8	3.3	2.5	2.4	2.7	2.5	1.1	1.2
Blast furnace	--	--	--	--	--	--	--	--
Steel furnace	3.8	3.3	2.5	2.4	2.7	2.5	1.1	1.2
BEA 62: Cincinnati, OH	3,466.2	3,331.3	3,276.2	3,640.8	3,957.3	3,620.1	2,673.5	2,987.4
Blast furnace	3,379.1	3,257.4	3,220.2	3,587.0	3,897.2	3,565.0	2,649.5	2,959.7
Steel furnace	87.1	73.9	56.0	53.8	60.1	55.1	24.0	27.7
BEA 66: Pittsburgh, PA	27,614.1	26,049.0	22,680.9	25,753.2	28,879.9	28,257.8	21,562.6	22,481.2
Blast furnace	26,936.3	25,510.9	22,302.7	25,381.7	28,452.0	27,838.1	21,373.7	22,276.6
Steel furnace	677.8	538.1	378.2	371.5	427.9	419.7	188.9	204.6
BEA 67: Youngstown, OH	8,291.6	7,522.4	6,806.3	7,682.4	8,665.1	8,486.4	6,215.2	6,834.0
Blast furnace	8,081.2	7,355.3	6,688.9	7,567.9	8,532.3	8,356.1	6,158.9	6,770.0
Steel furnace	210.4	167.1	117.4	114.5	132.8	130.3	56.3	64.0

Note: A factor relating iron ore consumption in blast furnaces to pig iron production was derived for each year by RRNA from the AISI Annual Statistical Report. These factors were then applied to RRNA estimates of pig iron production as shown in Table A-15. A factor relating iron ore consumption in steelmaking furnaces to raw steel production was also derived from the AISI Annual Statistical Report which was then applied to RRNA estimates for raw steel production by BEA segments shown in Table 11.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: American Iron and Steel Institute, Annual Statistical Report, 1969-76 eds. Pig iron production by BEA segments, 1969-76, from Table A-15. Raw steel production by BEA segments, 1969-76, from Table 11.

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Table A-2. Ohio River Basin: Consumption of Pig Iron, by Furnace Type and BEA or BEA Segments[a], Estimated 1969-76

(Thousands of tons)

BEA or BEA segment and Furnace type	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	27,560.6	25,300.0	23,373.1	26,060.2	29,145.5	28,455.3	21,693.8	23,438.1
Pneumatic	18,729.1	17,196.2	15,880.5	17,761.3	19,804.0	19,340.8	14,869.2	15,912.4
Electric arc	149.7	138.1	126.8	142.0	158.2	154.7	119.0	127.2
Open hearth	8,514.6	7,820.4	7,224.6	7,996.0	9,007.2	8,795.3	6,572.7	7,247.6
Foundry	167.2	145.3	141.2	160.9	176.1	164.5	132.9	150.9
BEA 48: Chattanooga, TN	46.0	40.0	38.8	43.4	48.5	45.3	36.6	40.7
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--	--	--
Foundry	46.0	40.0	38.8	43.4	48.5	45.3	36.6	40.7
BEA 49: Nashville, TN	2.7	2.4	2.3	2.6	2.9	2.7	2.2	2.4
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--	--	--
Foundry	2.7	2.4	2.3	2.6	2.9	2.7	2.2	2.4
BEA 50: Knoxville, TN	7.3	6.6	6.0	6.7	7.6	7.5	5.8	6.1
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	7.3	6.6	6.0	6.7	7.6	7.5	5.8	6.1
Open hearth	--	--	--	--	--	--	--	--
Foundry	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	1,934.5	1,864.8	1,846.7	1,840.6	2,203.7	2,033.9	1,518.6	1,716.8
Pneumatic	1,427.3	1,375.9	1,362.6	1,505.6	1,626.0	1,500.9	1,120.5	1,266.8
Electric arc	8.0	7.7	7.6	8.4	9.1	8.4	6.3	7.1
Open hearth	499.2	481.2	476.5	326.6	568.6	524.6	391.8	442.9
Foundry	--	--	--	--	--	--	--	--
BEA 55: Evansville, IN	3.6	3.6	3.5	3.9	4.2	3.9	2.9	3.3
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	3.6	3.6	3.5	3.9	4.2	3.9	2.9	3.3
Open hearth	--	--	--	--	--	--	--	--
Foundry	--	--	--	--	--	--	--	--
BEA 62: Cincinnati, OH	2,283.6	2,200.6	2,178.5	2,407.2	2,600.2	2,398.9	1,793.5	2,026.4
Pneumatic	1,427.6	1,376.1	1,362.8	1,506.0	1,626.2	1,500.3	1,121.1	1,266.8
Electric arc	10.8	11.0	10.3	11.4	12.3	11.3	8.5	9.6
Open hearth	831.6	801.7	794.0	877.0	947.4	874.0	653.1	738.0
Foundry	13.6	11.8	11.4	12.8	14.3	13.3	10.8	12.0
BEA 66: Pittsburgh, PA	17,813.0	16,204.8	14,764.9	16,668.8	18,576.5	18,331.2	14,158.4	14,999.6
Pneumatic	13,285.3	12,088.6	11,011.2	12,344.3	13,854.3	13,674.7	10,559.7	11,183.4
Electric arc	100.0	91.0	82.9	93.0	104.2	103.0	79.5	84.2
Open hearth	4,343.8	3,952.4	3,600.2	4,152.5	4,529.7	4,471.0	3,452.6	3,658.0
Foundry	83.9	72.8	70.6	79.0	88.3	82.5	66.6	74.1
BEA 67: Youngstown, OH	5,469.9	4,977.2	4,532.4	5,087.0	5,701.9	5,631.9	4,175.8	4,642.7
Pneumatic	2,588.9	2,355.6	2,143.9	2,405.4	2,697.5	2,664.9	2,067.9	2,195.4
Electric arc	20.0	18.2	16.5	18.6	20.8	20.6	16.0	16.9
Open hearth	2,840.0	2,585.1	2,353.9	2,639.9	2,961.5	2,925.7	2,075.2	2,408.7
Foundry	21.0	18.3	18.1	23.1	22.1	20.7	16.7	21.7

Note: Factors were derived for the amount of pig iron consumed per ton of raw steel produced for each type of furnace from AISI Annual Statistical Report for each year. These factors were then applied to the RRNA estimates of raw steel production by furnace type for individual BEA segments as shown in Table 12. The factors were as follows: basic oxygen furnaces, 0.828; electric arc furnace, 0.0238; open hearth furnace, 0.6431. A factor relating tons of pig iron consumed per ton of foundry shipment was obtained from Fordham University, Industrial Economic Research Institute, Purchased Ferrous Scrap: United States Demand and Supply Outlook, Table 27. This factor of 0.1154 tons per ton of production was then applied to RRNA estimates of foundry production by BEA segments as shown in Table A-17.

a. BEA segments defined as counties which are origins or destinations of waterborne movements.

Source: American Iron and Steel Institute, Annual Statistical Report, 1976 ed. Raw steel production by furnace type from Table 12. Pig iron factors from Fordham University, Industrial Economic Research Institute, Purchased Ferrous Scrap: United States Demand and Supply Outlook, Table 27. Foundry production by BEA segment from Table A-17.

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Table A-3. Ohio River Basin: Consumption of Steel Mill Products[a] by BEA or BEA Segments[b], Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	7,561.2	6,990.3	7,410.8	7,877.0	8,869.8	8,648.0	6,450.4	7,446.9
BEA 47: Huntsville, AL	38.3	33.6	37.5	39.2	44.9	43.8	32.6	37.1
BEA 48: Chattanooga, TN	272.7	252.2	267.3	279.4	319.9	311.9	232.7	264.1
BEA 49: Nashville, TN	440.5	407.4	431.8	451.3	516.7	503.8	375.8	426.7
BEA 50: Knoxville, TN	126.5	117.0	124.0	129.6	148.8	144.7	107.9	122.5
BEA 52: Huntington, WV	208.3	192.6	204.2	213.4	244.3	238.2	177.7	201.7
BEA 54: Louisville, KY	945.3	874.2	926.7	968.5	1,108.9	1,081.2	806.5	915.6
BEA 55: Evansville, IN	336.6	311.2	329.0	344.8	394.8	384.9	287.1	326.0
BEA 62: Cincinnati, OH	1,670.8	1,545.1	1,637.7	1,711.7	1,959.8	1,911.0	1,425.3	1,618.3
BEA 64: Columbus, OH	118.2	109.3	115.9	121.1	138.7	135.2	100.8	114.5
BEA 66: Pittsburgh, PA	2,532.7	2,342.2	2,482.7	2,594.8	2,970.9	2,896.8	2,160.7	2,453.1
BEA 67: Youngstown, OH	871.3	805.5	854.0	1,023.2	1,022.1	996.5	743.3	967.3

Note: Consumption of steel mill shapes and forms by manufacturing is reported for individual SMSA's in the Shapes and Forms. The SMSA's were aggregated into BEA segments and adjusted for the consumption of steel by the non-manufacturing sector using national distributions between manufacturing and non-manufacturing. Consumption figures for other years were based on the distribution among BEA segments in 1972, adjusted by trends shown in consumption nationwide. Net imports were included and allocated to BEA segments according to consumption patterns observed.

a. Includes bars, rods, angles, shapes, sheets, plates, pipe, tube, wire, and other steel products not elsewhere classified.

b. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Commerce, Census of Manufactures Special Report: Consumption of Selected Metal Mill Shapes and Forms, 1963 and 1972 eds.; and American Iron and Steel Institute, Annual Statistical Report, 1969-76 eds.

Table A-4. Ohio River Basin: Consumption of Ferroalloys by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	682.5	624.9	588.7	650.9	721.5	752.6	537.6	576.9
BEA 48: Chattanooga, TN	12.3	10.7	10.4	11.6	13.0	12.1	9.8	10.9
BEA 49: Nashville, TN	0.7	0.6	0.6	0.7	0.8	0.7	0.6	0.6
BEA 50: Knoxville, TN	4.6	4.2	3.8	4.3	4.8	4.7	3.7	3.9
BEA 52: Huntington, WV	42.9	41.4	41.0	45.3	48.9	45.1	33.7	38.0
BEA 55: Evansville, IN	2.3	2.3	2.2	2.5	2.7	2.5	1.8	2.1
BEA 62: Cincinnati, OH	56.1	54.1	53.2	58.8	63.6	58.8	44.1	49.8
BEA 66: Pittsburgh, PA	431.1	391.3	357.6	403.6	449.6	442.7	342.6	364.0
BEA 67: Youngstown, OH	132.5	120.3	109.9	124.1	138.1	186.0	101.3	107.6

Note: Factors were derived by RRNA relating ferroalloy consumption to raw steel production and foundry production. These factors were then applied to raw steel production estimates for individual BEA segments from Table 11, and foundry production estimates for individual BEA segments from Table A-17.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of the Interior, Bureau of Mines, Mineral Facts and Problems, 1975. Raw steel production by BEA segment from Table 11. Foundry production by BEA segment from Table A-17.

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Table A-5. Ohio River Basin: Consumption of Ferrous Castings by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	1,380.9	1,200.7	1,182.8	1,299.7	1,447.4	1,350.0	1,086.6	1,207.7
BEA 47: Huntsville, AL	6.9	6.0	6.0	6.5	7.2	6.7	5.4	6.0
BEA 48: Chattanooga, TN	49.0	42.6	42.0	46.1	51.3	47.9	38.6	42.8
BEA 49: Nashville, TN	79.2	68.8	67.8	74.5	83.9	77.4	62.3	69.2
BEA 50: Knoxville, TN	22.7	19.8	19.5	21.4	23.8	22.2	17.9	19.9
BEA 52: Huntington, WV	37.4	32.5	32.1	35.2	39.2	36.6	29.5	32.7
BEA 54: Louisville, KY	169.9	147.7	145.5	159.9	178.0	166.1	133.7	148.6
BEA 55: Evansville, IN	59.5	51.8	51.0	56.0	62.3	58.2	46.8	52.0
BEA 62: Cincinnati, OH	300.3	261.1	257.2	282.7	314.6	293.6	236.3	262.7
BEA 64: Columbus, OH	21.3	18.5	18.2	20.0	22.3	20.8	16.7	18.6
BEA 66: Pittsburgh, PA	455.2	395.8	389.8	428.5	476.8	445.0	358.2	398.2
BEA 67: Youngstown, OH	179.5	156.1	153.7	168.9	188.0	175.5	141.2	159.0

Note: U.S. consumption of ferrous castings for 1969-76 was obtained from the Department of Commerce, U.S. Industrial Outlook, 1975 and 1978, pp. 77 and 62 respectively. National data then distributed to BEA segments according to the distribution of steel consumption in each segment.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Commerce, Industry and Trade Administration, U.S. Industrial Outlook, 1975 and 1978 eds. American Iron and Steel Institute, Annual Statistical Report, 1976 ed.

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Table A-6. Ohio River Basin: Consumption of Iron and Steel Scrap, by Furnace Type and BEAs or BEA Segments[a], Estimated 1969-76

(Thousands of tons)

BEA and BEA segment and furnace type	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	23,942.0	21,468.9	19,849.8	23,375.8	25,196.9	25,457.3	19,387.8	21,259.1
Pneumatic	7,445.5	6,917.3	6,021.6	6,958.7	7,905.3	7,671.2	5,850.7	6,318.1
Electric arc	6,113.7	5,419.8	5,130.5	6,256.3	6,848.6	6,731.5	5,075.9	5,893.9
Open hearth	6,577.5	5,554.9	5,867.5	6,799.1	6,675.9	7,322.5	5,382.2	5,884.1
Foundry	2,375.3	2,062.4	2,003.9	2,283.8	2,500.1	2,337.7	1,887.6	2,143.3
Blast furnace	1,430.0	1,514.5	825.8	1,077.9	1,267.0	1,394.4	1,191.4	1,019.7
BEA 48: Chattanooga, TN	654.0	567.9	550.7	616.1	688.4	643.6	519.7	578.2
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--	--	--
Foundry	654.0	567.9	550.7	616.1	688.4	643.6	519.7	578.2
Blast furnace	--	--	--	--	--	--	--	--
BEA 49: Nashville, TN	38.5	33.4	32.5	36.2	40.5	37.9	30.5	33.9
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--	--	--
Foundry	38.5	33.4	32.5	36.2	40.5	37.9	30.5	33.9
Blast furnace	--	--	--	--	--	--	--	--
BEA 50: Knoxville, TN	296.1	258.8	242.7	296.8	327.1	324.9	247.2	284.7
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	296.1	258.8	242.7	296.8	327.1	324.9	247.2	284.7
Open hearth	--	--	--	--	--	--	--	--
Foundry	--	--	--	--	--	--	--	--
Blast furnace	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	1,402.7	1,329.6	1,291.4	1,491.9	1,609.5	1,515.6	1,124.2	1,287.3
Pneumatic	567.5	549.0	516.2	589.9	644.3	591.2	440.9	507.6
Electric arc	326.8	302.7	308.8	372.1	394.6	366.0	268.1	328.7
Open hearth	385.6	341.8	387.0	436.8	453.8	436.7	320.9	359.6
Foundry	--	--	--	--	--	--	--	--
Blast furnace	122.8	136.1	79.4	93.1	116.8	121.7	94.3	91.4
BEA 55: Evansville, IN	148.0	139.7	142.5	171.7	182.1	168.9	123.8	151.8
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	148.0	139.7	142.5	171.7	182.1	168.9	123.8	151.8
Open hearth	--	--	--	--	--	--	--	--
Foundry	--	--	--	--	--	--	--	--
Blast furnace	--	--	--	--	--	--	--	--
BEA 62: Cincinnati, OH	1,956.7	1,846.4	1,817.7	2,096.5	1,732.0	2,165.1	1,578.8	1,799.9
Pneumatic	566.6	549.1	591.4	590.0	644.4	640.9	441.1	502.6
Electric arc	440.1	432.9	415.8	501.0	532.5	493.0	361.5	442.6
Open hearth	642.4	569.5	644.3	727.5	242.8	727.7	534.8	599.2
Foundry	192.5	167.1	161.3	181.3	202.6	189.4	153.0	170.2
Blast furnace	115.1	127.8	74.9	96.7	109.7	114.1	88.4	85.3
BEA 66: Pittsburgh, PA	14,833.0	13,246.5	11,967.9	14,184.3	15,728.2	15,658.4	12,126.6	13,008.3
Pneumatic	5,282.1	4,870.1	4,171.8	4,836.4	5,547.7	5,388.9	4,155.0	4,436.9
Electric arc	4,086.9	3,572.6	3,352.2	4,096.7	4,511.2	4,483.6	3,394.4	3,901.8
Open hearth	3,355.6	2,907.4	2,923.9	3,444.8	3,615.5	3,722.3	2,827.2	2,969.8
Foundry	1,191.4	1,034.5	1,003.2	1,122.3	1,254.0	1,172.5	946.8	1,053.3
Blast furnace	917.0	961.9	516.8	684.1	800.4	891.1	803.2	646.5
BEA 67: Youngstown, PA	4,613.0	4,046.6	3,803.9	4,482.3	4,888.5	4,942.9	3,637.0	4,115.0
Pneumatic	1,029.3	949.1	812.2	942.4	1,068.9	1,050.2	813.7	871.0
Electric arc	815.8	713.1	668.5	818.0	901.1	895.1	680.9	784.3
Open hearth	2,193.9	1,836.2	1,911.8	2,190.0	2,363.8	2,435.8	1,699.3	1,955.5
Foundry	298.9	259.5	256.4	327.9	314.6	294.3	237.6	307.7
Blast furnace	275.1	288.7	155.0	204.0	240.1	267.5	205.5	196.5

Note: Factors relating ferrous scrap consumption to raw steel production by furnace type were derived from the AISI Annual Statistical Report. These factors were then applied to raw steel production by furnace type for the individual BEA segments shown in Table 11. A factor relating blast furnace consumption of ferrous scrap to pig iron production was obtained from the AISI Annual Statistical Report and applied to RRNA estimates of pig iron production by BEA segment, shown in Table A-15. The factor for foundry consumption of ferrous scrap was obtained from Fordham University, Industrial Economic Research Institute, Purchased Ferrous Scrap: United States Demand and Supply Outlook, Table 27. This factor was applied to RRNA estimates of foundry production by BEA segments shown in Table A-17.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: American Iron and Steel Institute, Annual Statistical Report, 1969, Tables 26 and 44. Raw steel production by furnace type for BEA segments from Table 11. Fordham University, Industrial Economic Research Institute, Purchased Ferrous Scrap: United States Demand and Supply Outlook, Table 27. Foundry production by BEA segment from Table A-17. Pig iron production by BEA segment from Table A-15.

Table A-7. Ohio River Basin: Consumption of Iron Ore and Concentrates by Furnace Type and BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons)

BEA and BEA segment	Estimated 1976	Projected				
		1980	1990	2000	2020	2040
Primary Study Areas	35,487.3	39,571.9	33,798.6	36,280.7	43,928.3	49,614.0
Blast furnace	35,164.8	39,213.6	33,422.8	35,861.4	43,395.1	49,012.2
Steel furnace	322.5	358.3	375.8	419.3	533.2	601.8
BEA 50: Knoxville, TN	2.3	2.7	3.1	3.7	5.0	5.8
Blast furnace	--	--	--	--	--	--
Steel furnace	2.3	2.7	3.1	3.7	5.0	5.8
BEA 52: Huntington, WV	3,181.2	3,920.8	4,340.4	5,007.9	6,679.2	7,755.7
Blast furnace	3,158.5	3,893.5	4,309.4	4,971.7	6,630.6	7,699.3
Steel furnace	22.7	27.3	31.0	36.2	48.6	56.4
BEA 55: Evansville, IN	1.2	1.6	2.0	2.5	3.6	4.3
Blast furnace	--	--	--	--	--	--
Steel furnace	1.2	1.6	2.0	2.5	3.6	4.3

(Continued)

Table A-7. (Continued)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040
BEA 62: Cincinnati, OH	2,987.4	3,541.7	2,773.6	3,026.2	3,933.5	4,486.7
Blast furnace	2,959.7	3,508.7	2,737.9	2,985.7	3,881.0	4,426.8
Steel furnace	27.7	33.0	35.7	40.5	52.5	59.9
BEA 66: Pittsburgh, PA	22,481.2	25,628.7	21,783.7	22,728.2	25,899.1	28,844.5
Blast furnace	22,276.6	25,395.4	21,546.8	22,469.0	25,577.6	28,486.4
Steel furnace	204.6	233.3	236.9	259.2	321.5	358.1
BEA 67: Youngstown, OH	6,834.0	6,476.4	4,895.8	5,512.2	7,407.9	8,517.0
Blast furnace	6,770.0	6,416.0	4,828.7	5,435.0	7,305.9	8,399.7
Steel furnace	64.0	60.4	67.1	77.2	102.0	117.3

Note: A factor relating iron ore consumption in blast furnaces to pig iron production was derived from the AISI Annual Statistical Report, 1976. This factor was then applied to RRNA projections of pig iron production as shown in Table A-18. A factor relating iron ore consumption in steelmaking furnaces to raw steel production was also derived from the AISI report and applied to RRNA projections of raw steel production by BEA segments shown in Table A-23. Underlying these projections are RRNA's forecasts for raw steel production by type of furnace shown in Table A-23.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: American Iron and Steel Institute, Annual Statistical Report, 1976. Pig iron production by BEA segments, 1976-2040, from Table A-18. Raw steel production by BEA segments, 1976-2040, from Table A-23.

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Table A-8. Ohio River Basin: Consumption of Pig Iron by Furnace Type and BEA or BEA Segments[a], Estimated 1976 and Projected 1980-2040

(Thousands of tons)

BEA or BEA segment and Furnace type	Estimated 1976	Projected 1980	1990	2000	2020	2040
Primary Study Areas	23,438.1	26,095.7	22,125.3	23,702.6	28,633.2	32,324.4
Pneumatic	15,912.4	18,897.1	21,385.7	23,106.3	27,706.2	31,269.6
Electric arc	127.2	149.9	369.8	360.5	613.7	692.9
Open hearth	7,247.6	6,869.1	165.9	--	--	--
Foundry	150.9	179.6	203.9	235.8	313.3	361.9
BEA 48: Chattanooga, TN	40.7	50.0	62.3	75.9	107.4	127.8
Pneumatic	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--
Foundry	40.7	50.0	62.3	75.9	107.4	127.8
BEA 49: Nashville, TN	2.4	3.6	4.8	5.9	8.7	10.6
Pneumatic	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--
Foundry	2.4	3.6	4.8	5.9	8.7	10.6
BEA 50: Knoxville, TN	6.1	7.2	8.2	9.7	13.2	15.4
Pneumatic	--	--	--	--	--	--
Electric arc	6.1	7.2	8.2	9.7	13.2	15.4
Open hearth	--	--	--	--	--	--
Foundry	--	--	--	--	--	--
BEA 52: Huntington, WV	1,716.8	2,116.9	2,343.5	2,703.5	3,604.9	4,182.6
Pneumatic	1,266.8	2,105.1	2,328.4	2,685.0	3,579.2	4,152.8
Electric arc	7.1	11.8	15.1	18.5	25.7	29.8
Open hearth	442.9	--	--	--	--	--
Foundry	--	--	--	--	--	--
BEA 55: Evansville, IN	3.3	4.1	5.2	6.5	9.5	11.5
Pneumatic	--	--	--	--	--	--
Electric arc	3.3	4.1	5.2	6.5	9.5	11.5
Open hearth	--	--	--	--	--	--
Foundry	--	--	--	--	--	--
BEA 62: Cincinnati, OH	2,026.4	2,412.4	1,882.1	2,053.2	2,667.8	3,040.7
Pneumatic	1,266.8	1,507.6	1,823.1	1,983.5	2,577.1	2,937.1
Electric arc	9.6	11.3	41.9	50.0	64.8	73.9
Open hearth	738.0	878.3	--	--	--	--
Foundry	12.0	15.2	17.1	19.7	25.9	29.7
BEA 66: Pittsburgh, PA	14,999.7	17,101.4	14,509.4	15,123.4	17,215.1	19,178.1
Pneumatic	11,183.4	12,748.6	14,033.6	14,759.2	16,716.1	18,621.1
Electric arc	84.2	95.9	217.0	261.2	369.6	411.8
Open hearth	3,658.0	4,169.3	165.9	--	--	--
Foundry	74.1	87.6	92.9	103.0	129.4	145.2
BEA 67: Youngstown, OH	4,642.7	4,400.1	3,309.8	3,724.5	5,006.6	5,757.7
Pneumatic	2,195.4	2,535.8	3,200.6	3,592.2	4,833.8	5,558.6
Electric arc	16.9	19.6	82.4	101.0	130.9	150.5
Open hearth	2,408.7	1,821.5	--	--	--	--
Foundry	21.7	23.2	26.8	31.3	41.9	48.6

Note: A factor was derived for the amount of pig iron consumed per ton of raw steel produced for each type of furnace from AISI Annual Statistical Reports 1976. This factor was then applied to the RRNA estimates of raw steel production by furnace type of individual BEA segments as shown in Table A-23. A factor relating pig iron consumed per ton of foundry shipments was obtained from Fordham University, Industrial Economic Research Institute, Purchased Ferrous Scrap: United States Demand and Supply Outlook, Table 27. This factor was then applied to RRNA estimates of foundry production by BEA segments as shown in Table A-21.

a. BEA segments defined as counties which are origins or destinations of waterborne movements.

Source: American Iron and Steel Institute, Annual Statistical Report, 1976. Raw steel production by furnace type from Table A-23. Fordham University, Industrial Economic Research Institute, Purchased Ferrous Scrap: United States Demand and Supply Outlook, Table 27. Foundry production by BEA segment from Table A-21.

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Table A-9. Ohio River Basin: Consumption of Steel Mill Products by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	7,446.9	9,171.1	12,923.8	18,105.8	31,561.6	41,900.0	3.8	2.1
BEA 47: Huntsville, AL	37.1	47.6	72.3	106.6	203.3	281.4	4.5	2.5
BEA 48: Chattanooga, TN	264.1	347.3	558.2	844.7	1,651.8	2,318.6	5.0	2.6
BEA 49: Nashville, TN	426.7	560.6	929.8	1,430.2	2,856.8	4,049.7	5.2	2.6
BEA 50: Knoxville, TN	122.5	154.9	248.0	366.4	691.9	954.2	4.7	2.4
BEA 52: Huntington, WV	201.7	260.1	400.5	690.6	1,242.5	1,670.2	5.3	2.2
BEA 54: Louisville, KY	915.6	1,196.1	1,897.0	2,848.8	5,527.8	7,728.9	4.8	2.5
BEA 55: Evansville, IN	326.0	411.1	612.0	884.4	1,628.6	2,215.2	4.2	2.3
BEA 62: Cincinnati, OH	1,618.3	1,947.6	2,597.2	3,476.8	5,753.0	7,419.4	3.2	1.9
BEA 64: Columbus, OH	114.5	139.8	191.2	260.7	437.3	567.3	3.5	2.0
BEA 66: Pittsburgh, PA	2,453.1	2,913.1	3,765.5	4,943.8	7,760.2	9,734.9	3.0	1.7
BEA 67: Youngstown, OH	967.3	1,192.9	1,652.1	2,252.8	3,808.4	4,960.2	3.6	2.0

Note: Consumption of steel products for 1976 was obtained from Table A-3. Average annual growth rates for earnings in fabricated metals and ordinance (SIC 34), machinery, excluding electrical (SIC 35), and electrical machinery and supplies (SIC 36), by BEA, were obtained from U.S. Department of Commerce, OBERS Projections. Those growth rates were applied to the 1976 consumption of steel products for individual BEA segments to project future consumption of steel mill products.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Consumption of steel products by BEA segments in 1976 from Table A-3. Average annual growth rates from U.S. Water Resources Council, OBERS Projections, Regional Economic Activity in the U.S., Series E, 1972 ed.

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Table A-10. Ohio River Basin: Consumption of Ferroalloys by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	577.0	644.6	679.4	759.8	969.0	1,095.5	1.2	0.9
BEA 48: Chattanooga, TN	10.9	13.4	16.7	20.3	28.7	34.2	2.6	1.3
BEA 49: Nashville, TN	0.6	1.0	1.3	1.6	2.3	2.8	4.2	1.4
BEA 50: Knoxville, TN	3.9	4.6	5.3	6.2	8.1	9.3	2.0	1.0
BEA 52: Huntington, WV	38.1	46.0	52.1	60.8	81.8	95.0	2.0	1.1
BEA 55: Evansville, IN	2.1	2.6	3.3	4.1	6.0	7.3	2.8	1.5
BEA 62: Cincinnati, OH	49.8	59.6	64.6	73.4	95.2	108.5	1.6	1.0
BEA 66: Pittsburgh, PA	364.0	415.7	423.3	463.5	575.3	641.1	1.0	0.8
BEA 67: Youngstown, OH	107.6	101.7	112.8	129.9	171.6	197.3	0.8	1.1

Note: Factors were derived by RRNA relating ferroalloy consumption to raw steel production and foundry production. These factors were then applied to raw steel production estimates for individual BEA segments from Table A-23, and foundry production estimates for individual BEA segments from Table A-21.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of the Interior, Bureau of Mines, Mineral Facts and Problems, 1975. Raw steel production by BEA segment from Table A-23. Foundry production by BEA segment from Table A-21.

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Table A-11. Ohio River Basin: Consumption of Ferrous Castings by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	1,207.7	1,487.4	2,095.7	2,935.9	5,117.6	6,793.6	3.8	2.1
BEA 47: Huntsville, AL	6.0	7.7	11.7	17.3	32.9	45.5	4.5	2.4
BEA 48: Chattanooga, TN	42.8	56.3	90.5	136.9	267.7	375.8	5.0	2.6
BEA 49: Nashville, TN	69.2	90.9	150.8	231.9	463.3	656.7	5.2	2.6
BEA 50: Knoxville, TN	19.9	25.2	40.3	59.5	112.5	155.1	4.7	2.4
BEA 52: Huntington, WV	32.7	42.2	64.9	111.9	201.4	270.7	5.3	2.2
BEA 54: Louisville, KY	148.6	194.1	307.9	462.4	897.2	1,254.4	4.8	2.5
BEA 55: Evansville, IN	52.0	65.6	97.6	141.1	259.8	353.4	4.2	2.3
BEA 62: Cincinnati, OH	262.7	316.2	421.6	564.4	933.9	1,204.4	3.2	1.9
BEA 64: Columbus, OH	18.6	22.7	31.1	42.4	71.1	92.2	3.5	2.0
BEA 66: Pittsburgh, PA	398.2	472.9	611.2	802.5	1,259.7	1,580.3	3.0	1.7
BEA 67: Youngstown, OH	157.0	193.6	268.1	365.6	618.1	805.1	3.6	2.0

Note: Consumption of ferrous castings on a national basis were obtained from the U.S. Department of Commerce. Consumption for Ohio River Basin BEA segments was obtained by distributing the national consumption according to RRNA's estimates for steel consumption by BEA segment. The relationship of foundry consumption to steel consumption was maintained throughout the projections.

a. BEA segments are defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Consumption of foundry products by BEA segment for 1976 from Table A-5. Factor relating ORB steel consumption to U.S. steel consumption was obtained from data presented in Table A-9 and Table 1 of the American Iron and Steel Institute, Annual Statistical Report, 1976. U.S. foundry consumption from U.S. Department of Commerce, Industry and Trade Administration, U.S. Industrial Outlook, p. 62.

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Table A-12. Ohio River Basin: Consumption of Iron and Steel Scrap by Furnace Type and BEAs or BEA Segments[a], Estimated 1976 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	21,259.1	23,691.9	29,663.2	34,220.4	45,105.1	51,816.7	2.0	1.0
Pneumatic	6,318.1	7,497.5	8,524.3	9,133.0	10,992.1	12,615.1	1.5	0.8
Electric arc	5,893.9	6,946.0	17,135.6	20,699.2	28,406.0	32,586.3	5.4	1.1
Open hearth	5,884.1	5,576.5	134.7	--	--	--	--	--
Blast furnace	1,019.7	1,120.3	972.2	1,038.0	1,255.3	1,441.4	0.1	0.8
Foundry	2,143.3	2,551.8	2,896.4	3,350.2	4,451.7	5,173.9	1.9	1.1
BEA 48: Chattanooga, TN	578.2	710.2	885.4	1,078.2	1,525.4	1,815.7	2.6	1.3
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--	--	--
Blast furnace	--	--	--	--	--	--	--	--
Foundry	578.2	710.2	885.4	1,078.2	1,525.4	1,815.7	2.6	1.3
BEA 49: Nashville, TN	33.9	51.6	67.5	84.4	123.8	150.1	3.9	1.4
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	--	--	--	--	--	--	--	--
Open hearth	--	--	--	--	--	--	--	--
Blast furnace	--	--	--	--	--	--	--	--
Foundry	33.9	51.6	67.5	84.4	123.8	150.1	3.9	1.4
BEA 50: Knoxville, TN	284.7	332.8	382.2	449.3	610.1	711.4	1.9	1.2
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	284.7	332.8	382.2	449.3	610.1	711.4	1.9	1.2
Open hearth	--	--	--	--	--	--	--	--
Blast furnace	--	--	--	--	--	--	--	--
Foundry	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	1,287.3	1,494.5	1,746.0	2,064.1	2,803.2	3,268.7	2.0	1.2
Pneumatic	507.6	835.2	923.8	1,065.3	1,420.0	1,655.8	3.1	1.1
Electric arc	328.7	546.6	697.5	854.9	1,191.3	1,389.1	4.1	1.2
Open hearth	359.6	--	--	--	--	--	--	--
Blast furnace	91.4	112.7	124.7	143.9	191.9	223.8	1.9	1.1
Foundry	--	--	--	--	--	--	--	--
BEA 55: Evansville, IN	151.8	190.0	241.6	301.2	439.9	532.1	2.9	1.4
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	151.8	190.0	241.6	301.2	439.9	532.1	2.9	1.4
Open hearth	--	--	--	--	--	--	--	--
Blast furnace	--	--	--	--	--	--	--	--
Foundry	--	--	--	--	--	--	--	--
BEA 62: Cincinnati, OH	1,799.9	2,138.4	2,986.6	3,469.0	4,504.4	5,134.7	2.7	1.0
Pneumatic	502.6	598.1	723.3	786.9	1,022.4	1,165.5	1.9	1.0
Electric arc	442.6	526.7	1,941.3	2,316.4	3,002.3	3,422.4	7.1	1.0
Open hearth	599.2	713.0	--	--	--	--	---	--
Blast furnace	85.3	85.2	79.0	86.2	112.0	127.7	(b)	1.0
Foundry	170.2	215.4	243.0	279.5	367.7	419.1	2.1	1.0
BEA 66: Pittsburgh, PA	13,008.3	14,869.2	17,698.6	20,068.7	26,330.7	30,174.1	1.8	1.0
Pneumatic	4,436.9	5,057.9	5,567.7	5,855.6	6,631.9	7,599.9	1.2	0.7
Electric arc	3,901.8	4,444.4	10,052.3	12,099.2	17,119.6	19,618.5	4.8	1.2
Open hearth	2,969.8	3,384.8	134.7	--	--	--	--	--
Blast furnace	646.5	737.0	624.7	650.9	740.3	848.4	(b)	0.7
Foundry	1,053.3	1,245.1	1,319.2	1,463.0	1,838.9	2,107.3	1.4	1.2
BEA 67: Youngstown, OH	4,115.0	3,905.2	5,655.3	6,705.5	8,767.6	10,029.9	2.1	1.0
Pneumatic	871.0	1,006.1	1,309.5	1,425.2	1,917.8	2,193.9	2.1	1.1
Electric arc	784.3	905.5	3,820.7	4,678.2	6,042.8	6,912.8	7.7	1.0
Open hearth	1,955.5	1,478.7	--	--	--	--	---	--
Blast furnace	196.5	135.4	143.8	157.0	211.1	241.5	(0.9)	1.1
Foundry	307.7	329.5	381.3	445.1	595.9	681.7	1.6	1.1

Note: Factors relating iron and steel scrap consumption to raw steel production by furnace type were derived from the AISI Annual Statistical Report. These factors were then applied to raw steel production by furnace type for the individual BEA segments, shown in Table A-23. A factor relating blast furnace consumption of iron and steel scrap to pig iron production was also derived from the AISI Annual Statistical Report and applied to RRNA estimates of pig iron production by BEA segment, shown in Table A-18. A factor for foundry consumption of ferrous scrap was obtained from Fordham University, Industrial Economics Research Institute. Purchased Ferrous Scrap: United States Demand and Suply Outlook, Table 27. This factor was applied to RRNA estimates of foundry production by BEA segments, shown in Table A-21. For the year 2000, 2020, and 2040 scrap consumption includes the consumption of the sponge iron which was projected for the ORB as 1 million tons in 2000, 2 million tons in 2020 and 3 million tons in 2040.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

b. Value is less than 0.1.

Source: American Iron and Steel Institute, Annual Statistical Report, 1976, Tables 26 and 44. Raw steel production by furnace type for BEA segments from Table A-23. Fordham University, Industrial Economic Research Institute, Purchased Ferrous Scrap: United States Demand and Supply Outlook, Table 27. Foundry production by BRA segment from Table A-21. Pig iron production by BEA segment from Table A-18.

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Table A-13. Ohio River Basin: Production of Iron and Steel Scrap, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment		1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas		18,218.2	16,523.5	15,264.8	17,589.5	19,217.0	19,114.4	14,561.7	15,671.1
BEA 48:	Chattanooga, TN	759.4	656.0	608.3	767.8	793.9	841.7	640.4	680.0
BEA 49:	Nashville, TN	356.0	307.5	285.1	359.9	372.1	394.5	300.2	320.1
BEA 50:	Knoxville, TN	182.1	162.1	148.7	175.7	190.1	193.8	149.0	159.4
BEA 52:	Huntington, W.V.	1,699.3	1,564.2	1,508.7	1,760.4	1,866.5	1,828.4	1,377.1	1,513.2
BEA 54:	Louisville, KY	.4	.3	.3	.4	.4	.4	.3	.3
BEA 55:	Evansville, IN	478.7	419.6	392.3	487.3	506.4	528.6	401.4	432.4
BEA 62:	Cincinnati, OH	1,846.6	1,721.9	1,659.6	1,918.4	2,040.8	1,979.2	1,489.3	1,643.1
BEA 64:	Columbus, OH	98.9	85.4	79.2	100.0	103.4	109.6	83.4	87.2
BEA 66:	Pittsburgh, PA	9,576.7	8,693.8	7,925.3	8,995.7	9,985.7	9,892.1	7,633.2	8,085.3
BEA 67:	Youngstown, OH	3,220.1	2,912.7	2,657.3	3,023.9	3,357.7	3,346.1	2,487.4	2,750.1

Note: A factor relating home scrap production to raw steel production was derived from the Institute of Scrap Iron and Steel, Facts, 1977 ed., and the American Iron and Steel Institute, Annual Statistical Report, 1977 ed. This factor was then applied to the RRNA estimates of raw steel production by BEA segment, shown in Table 11. Purchased scrap production (prompt industrial and obsolete scrap) was estimated by RRNA from a survey of scrap processors and dealers.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Raw steel production by BEA segment from Table 11. U.S. home scrap production from Institute of Scrap Iron and Steel, Facts, 1977 ed. U.S. raw steel production from American Iron and Steel Institute, Annual Statistical Report, 1977 ed. Purchased scrap production estimated by RRNA from a survey of scrap processors and dealers.

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Table A-14. Ohio River Basin: Production of Ferroalloys, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	2,142.7	2,009.4	1,804.2	2,101.9	2,096.1	1,899.8	1,602.9	1,666.9
BEA 48: Chattanooga, TN	40.8	38.2	34.4	40.0	39.9	36.2	30.5	31.7
BEA 52: Huntington, WV	112.8	105.8	95.0	110.6	110.3	100.0	84.4	87.7
BEA 64: Columbus, OH	535.1	501.8	450.5	524.9	523.5	474.4	400.2	416.3
BEA 66: Pittsburgh, PA	1,065.9	999.6	897.5	1,045.7	1,042.7	945.1	797.4	829.3
BEA 115: Paducah, KY	388.1	364.0	326.8	380.7	379.7	344.1	290.4	301.9

Note: Production of ferroalloys for individual states in the area served by the ORS was obtained from the Bureau of Mines, Minerals Yearbook. These were allocated to BEA segments according to the capacities of individual plants as listed by Metal Bulletins, Ferroalloy Survey, 1975 ed.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Capacity of individual ferroalloy plants from Metal Bulletins, Ferroalloy Survey, 1975 ed. Ferroalloy production by state from U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1974 ed.

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Table A-15. Ohio River Basin: Production of Pig Iron, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	28,430.6	26,114.8	24,149.4	26,881.2	30,095.1	29,360.0	22,381.1	24,027.5
BEA 52: Huntington, WV	2,441.3	2,347.3	2,322.7	2,322.1	2,775.2	2,562.7	1,917.3	2,078.3
BEA 62: Cincinnati, OH	2,287.2	2,204.2	2,182.0	2,411.1	2,604.4	2,402.8	1,796.4	2,029.7
BEA 66: Pittsburgh, PA	18,232.2	16,586.1	15,112.3	17,061.0	19,013.6	18,762.6	14,491.6	15,276.8
BEA 67: Youngstown, OH	5,469.9	4,977.2	4,532.4	5,087.0	5,701.9	5,631.9	4,175.8	4,642.7

Note: Production of pig iron was based upon RRNA estimates of pig iron consumption as reported in Table A-2. Since most consumers of pig iron are the integrated steel producers, they usually produce according to their own requirements. Therefore, the estimates for pig iron consumption by BEA and BEA segment were used as the basis for estimated pig iron production. Adjustments were made to individual BEA segments to account for merchant pig iron production.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Pig iron consumption from Table A-2; interviews with steel industry officials.

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Table A-16. Ohio River Basin: Production of Steel Mill Products[a], by BEAs or BEA Segments[b], Estimated 1969-76

(Thousands of tons)

BEA and BEA segment		1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas		28,121.3	26,753.9	25,983.0	28,453.0	33,259.9	32,778.5	22,914.7	25,048.5
BEA 50:	Knoxville, TN	203.3	191.6	183.4	202.4	236.9	236.2	166.6	180.6
BEA 52:	Huntington, W.V.	1,892.1	1,889.9	1,968.3	2,078.8	2,410.8	2,244.6	1,524.6	1,759.2
BEA 55:	Evansville, IN	103.6	103.5	107.8	113.9	132.0	122.8	83.5	96.3
BEA 62:	Cincinnati, OH	2,314.9	2,312.3	2,408.1	2,543.4	2,949.7	2,746.2	1,865.4	2.152.3
BEA 66:	Pittsburgh, PA	18,015.6	16,984.9	16,269.7	17,944.6	21,013.5	20,931.2	14,692.1	15,891.3
BEA 67:	Youngstown, OH	5,591.8	5,271.7	5,045.7	5,569.9	6,517.0	6,497.5	4,582.5	4,968.8

Note: Production of steel products by BEA segment was calculated by adjusting raw steel production data by the national proportion of net steel product shipments to raw steel production for each year. Raw steel production data were compiled by RRNA using figures reported annually for geographical districts by the American Iron and Steel Institute. These were classified into individual BEA segments by using the raw steel making capacities of individual plants.

a. Includes bars, rods, angles, shapes, sheets, plates, pipe, tube, wire, and other steel products not elsewhere classified.

b. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: American Iron & Steel Institute, Raw Steel by Geographical Districts, 1969-76 eds.; American Iron and Steel Institute, Directory of Iron and Steel Works in the United States and Canada, 1977 ed.; Institute for Iron Steel Studies, Commentary, Feb. & Mar. 1973; Basic Oxygen Process Association L-O Process Newsletter, Zurich Switzerland, June 1977; American Iron and Steel Institute, Annnual Statistical Report, 1969-76 eds.

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Table A-17. Ohio River Basin: Production of Ferrous Castings, by BEAs or BEA Segments[a], Estimated 1969-76
(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	1,266.5	1,099.7	1,086.4	1,393.1	1,333.1	1,246.4	1,006.4	1,307.4
BEA 48: Chattanooga, TN	398.9	346.4	335.9	375.8	419.9	392.6	317.0	352.7
BEA 49: Nashville, TN	23.5	20.4	19.8	22.1	24.7	23.1	18.6	20.7
BEA 62: Cincinnati, OH	117.4	101.9	98.8	110.6	123.6	115.5	93.3	103.8
BEA 66: Pittsburgh, PA	726.7	631.0	611.9	684.6	764.9	715.2	577.5	642.5
BEA 67: Youngstown, OH	182.3	158.3	156.4	200.0	191.9	179.5	144.9	187.7

Note: Production figures were derived from value of shipments for iron and steel foundries reported by SMSAs and counties in the U.S. Department of Commerce, Census of Manufactures, 1972 ed. The relationship between value of shipments and tonnages was obtained from the U.S. Department of Commerce, U.S. Industrial Outlook, 1977 ed. The distribution of ferrous casting production in 1972 was applied to iron and steel foundry shipments reported on a national basis annually by the U.S. Department of the Interior, Bureau of Mines in Mineral Commodity Profile: Iron and Steel, 1978.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Sources: U.S. Department of Commerce, Census of Manufactures, 1972 ed. and U.S. Industrial Outlook, 1977 ed.; U.S. Department of the Interior, Bureau of Mines, Mineral Commodity Profile: Iron and Steel, 1978.

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Table A-18. Ohio River Basin: Production of Pig Iron, by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1976-2000	2000-2040
Primary Study Areas	24,027.5	26,892.0	22,920.6	24,592.9	29,759.3	33,611.4	0.1	0.8
BEA 52: Huntington, WV	2,078.3	2,670.1	2,955.3	3,409.5	4,547.1	5,280.0	1.9	1.1
BEA 62: Cincinnati, OH	2,029.7	2,406.2	1,877.6	2,047.5	2,661.5	3,035.8	(b)	1.0
BEA 66: Pittsburgh, PA	15,276.8	17,415.6	14,776.3	15,408.7	17,540.5	19,535.3	(b)	0.6
BEA 67: Youngstown, OH	4,642.7	4,400.1	3,311.4	3,727.2	5,010.2	5,760.3	(.9)	1.1

Note: Production of pig iron was based upon RRNA estimates of pig iron consumption as shown in Table A-8. Since most consumers of pig iron are the integrated steel producers, they usually produce according to their own requirements. Therefore, the projections of pig iron consumption by BEA and BEA segment were used as the basis for projecting pig iron production. Adjustments were made to individual BEA segments to account for merchant pig iron production.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

b. Value is less than 0.1 percent.

Source: Pig iron consumption from Table A-8; interviews with steel industry officials.

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Table A-19. Ohio River Basin: Production of Steel Mill Products, by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1976-2000	2000-2040
Primary Study Areas	25,048.5	27,863.7	30,479.2	34,469.2	44,437.1	50,497.3	1.3	1.0
BEA 50: Knoxville, TN	180.6	211.3	253.1	301.6	415.1	487.3	2.2	1.2
BEA 52: Huntington, WV	1,759.2	2,126.8	2,514.8	2,973.6	4,052.6	4,733.9	2.2	1.2
BEA 55: Evansville, IN	96.3	120.7	160.0	202.2	299.3	364.5	3.1	1.5
BEA 62: Cincinnati, OH	2,152.3	2,565.1	2,892.9	3,327.7	4,377.1	5,022.4	1.8	1.0
BEA 66: Pittsburgh, PA	15,891.3	18,138.3	19,218.2	21,313.1	26,789.5	30,044.5	1.2	.9
BEA 67: Youngstown, OH	4,968.8	4,701.5	5,440.2	6,351.0	8,503.5	9,844.7	1.0	1.1

Note: Production of steel mill products by BEA segments was projected for 1980-2020 based upon the growth in earnings for primary metals (SIC 33) as estimated by the U.S. Department of Commerce, OBERS Projections. For the period of 2020-2040, a growth rate of half of the 2000-2020 period was projected.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Steel mill production for 1976 from Table A-16. Growth rates for earnings in primary metals industry were derived from the U.S. Water Resources Council, 1972 OBERS Projections, Regional Economic Activity in the U.S., Series E, 1972 ed.

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Table A-20. Ohio River Basin: Production of Ferroalloys, by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1976-2000	2000-2040
Primary Study Areas	1,666.9	1,854.7	2,186.9	2,653.8	3,894.0	4,725.2	2.0	1.5
BEA 48: Chattanooga, TN	31.7	34.7	48.2	64.6	108.5	140.8	3.0	2.0
BEA 52: Huntington, WV	87.7	101.4	130.2	167.2	265.5	335.0	2.7	1.8
BEA 64: Columbus, OH	416.3	455.6	517.9	618.1	896.3	1,080.2	1.7	1.4
BEA 66: Pittsburgh, PA	829.3	890.1	970.7	1,133.2	1,595.3	1,894.3	1.3	1.2
BEA 115: Paducah, KY	301.9	372.9	519.9	670.7	1,028.4	1,274.9	3.4	2.6

Note: Projections of ferroalloy production were based on the OBERS projections of growth in earnings by the primary metals industry for individual BEAs. These growth rates were adjusted upwards by a factor of 1.5 reflecting the views of industry and government officials, who believe that the growth rate for primary metals, which is based primarily on steel production, does not accurately forecast the growth in the ferroalloys industry, which is only a small proportion of all primary metals. This adjustment was made for each BEA or BEA segment with the exception of BEA 115. This was due to the absence of substantial steel production in the area, and thus the OBERS projections were felt to accurately forecast the growth in ferroalloy production.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Ferroalloy production by BEA segment for 1976 from Table A-14. Growth rates in earnings of the primary metals industry by BEAs from U.S. Water Resources Council, OBERS Projections, Regional Economic Activity in the U.S., Series E, 1972 ed. Adjustments to OBERS based on interviews with industry sources and U.S. Department of the Interior, Bureau of Mines officials.

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Table A-21. Ohio River Basin: Production of Ferrous Castings, by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	1,307.4	1,556.6	1,766.8	2,043.6	2,715.5	3,135.3	1.9	1.1
BEA 48: Chattanooga, TN	352.7	433.2	540.1	657.7	930.5	1,107.6	2.6	1.3
BEA 49: Nashville, TN	20.7	31.5	41.2	51.5	75.5	91.5	3.9	1.4
BEA 62: Cincinnati, OH	103.8	131.4	148.2	170.5	224.3	257.4	2.1	1.0
BEA 66: Pittsburgh, PA	642.5	759.5	804.7	892.4	1,121.7	1,258.0	1.4	.9
BEA 67: Youngstown, OH	187.7	201.0	232.6	271.5	363.5	420.8	1.5	1.1

Note: Production of ferrous castings by BEA or BEA segment was projected for 1980-2020 based upon the growth in earnings for primary metals (SIC 33) as provided in OBERS Projections.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Ferrous castings by BEA segments for 1976 from Table A-17. Average annual growth rates were derived from U.S. Water Resources Council, OBERS Projections, Regional Economic Activity in the U.S., Series E, 1972 ed.

BEST DOCUMENT AVAILABLE

Table A-22. Ohio River Basin: Production of Iron and Steel Scrap by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1976-2000	2000-2040
Primary Study Areas	15,671.1	17,187.3	19,198.6	21,172.8	26,893.8	31,566.4	1.2	1.0
BEA 48: Chattanooga, TN	680.0	777.3	1,280.2	1,470.4	1,976.8	2,288.6	3.3	1.1
BEA 49: Nashville, TN	320.1	365.9	602.6	692.2	930.6	1,079.6	3.3	1.1
BEA 50: Knoxville, TN	159.4	181.9	239.5	273.9	364.3	420.4	2.3	1.1
BEA 52: Huntington, WV	1,513.1	1,758.7	2,278.6	2,595.5	3,435.7	3,954.8	2.3	1.1
BEA 54: Louisville, KY	0.3	0.3	0.5	0.6	0.8	0.9	2.9	1.0
BEA 55: Evansville, IN	432.4	497.9	792.1	913.5	1,233.2	1,433.6	3.2	1.1
BEA 62: Cincinnati, OH	1,643.1	1,896.3	2,320.5	2,603.9	3,381.5	3,855.1	1.9	1.0
BEA 64: Columbus, OH	87.2	99.7	161.9	188.6	253.5	294.1	3.3	1.1
BEA 66: Pittsburgh, PA	8,085.3	8,999.0	8,630.9	9,200.1	11,141.0	13,491.4	0.5	1.0
BEA 67: Youngstown, OH	2,750.1	2,610.3	2,884.5	3,234.1	4,176.4	4,747.9	0.7	1.0

Note: Production of home and purchased ferrous scrap were estimated for the Ohio River Basin. For home scrap production, a factor relating national home scrap production to national raw steel production was applied to RRNA's estimates of raw steel production by BEA segment. In 1980, the factor used was .33 tons of home scrap per ton of steel produced, in 1990, .30; in 2000, .29; in 2020, .28; and in 2040, .27. These factors reflect the further implementation of the continuing casting process in steelmaking. Purchased scrap requirements in the ORB were projected as the residual of ORB home scrap consumption from the projection of total scrap consumption in the ORB. The purchased scrap requirement was then allocated to BEA segment according to historical distribution of purchased scrap production.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Raw steel production by BEA segment from Table A-23. Factor relating home scrap production to raw steel production from Institute of Scrap Iron and Steel, Facts, 1977 ed. ORB consumption of scrap from Table A-12.

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Table A-23. Ohio River Basin: Production of Raw Steel by Furnace Type and BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA or BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Primary Study Areas	35,834.8	39,805.2	41,752.3	46,580.0	59,249.5	66,876.9	1.1	0.9
Pneumatic	19,217.9	22,822.7	25,949.0	27,801.9	33,461.6	37,765.3	1.6	0.8
Electric arc	5,346.9	6,301.4	15,545.3	18,778.1	25,787.9	29,111.6	5.4	1.1
Open hearth	11,270.0	10,681.1	258.0	--	--	--	--	--
BEA 50: Knoxville, TN	258.3	301.9	346.7	407.6	553.9	645.4	1.9	1.2
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	258.3	301.9	346.7	407.6	553.9	645.4	1.9	1.2
Open hearth	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	2,516.8	3,038.3	3,444.9	4,018.4	5,403.5	6,269.4	2.0	1.1
Pneumatic	1,529.9	2,542.4	2,812.1	3,242.8	4,322.8	5,015.5	3.2	1.1
Electric arc	298.2	495.9	632.8	775.6	1,080.7	1,253.9	4.1	1.2
Open hearth	688.7	--	--	--	--	--	--	--
BEA 55: Evansville, IN	137.7	172.4	219.2	273.2	399.1	482.8	2.9	1.4
Pneumatic	--	--	--	--	--	--	--	--
Electric arc	137.7	172.4	219.2	273.2	399.1	482.8	2.9	1.4
Open hearth	--	--	--	--	--	--	--	--
BEA 62: Cincinnati, OH	3,079.1	3,664.3	3,962.9	4,496.6	5,836.1	6,651.4	1.6	1.0
Pneumatic	1,530.0	1,820.8	2,201.8	2,395.5	3,112.4	3,547.2	1.9	1.0
Electric arc	401.5	477.8	1,761.1	2,101.4	2,723.7	3,104.2	7.1	1.0
Open hearth	1,147.6	1,365.7	--	--	--	--	--	--
BEA 66: Pittsburgh, PA	22,734.4	25,911.9	26,326.3	28,801.5	35,719.3	39,789.9	1.0	.8
Pneumatic	13,506.5	15,396.9	16,948.9	17,825.2	20,188.5	22,489.3	1.2	.6
Electric arc	3,539.7	4,031.9	9,119.4	10,976.3	15,530.8	17,300.6	4.8	1.1
Open hearth	5,688.2	6,483.1	258.0	--	--	--	--	--
BEA 67: Youngstown, OH	7,108.5	6,716.4	7,452.3	8,582.4	11,338.0	13,038.0	.8	1.1
Pneumatic	2,651.5	3,062.6	3,986.2	4,338.4	5,837.9	6,713.3	2.0	1.1
Electric arc	711.5	821.5	3,466.1	4,244.0	5,500.1	6,324.7	7.7	1.0
Open hearth	3,745.5	2,832.3	--	--	--	--	--	--

Note: Raw steel production by furnace type was derived from the projections for steel production shown in Table A-19. The following yield rates were applied to the steel production to obtain the total raw steel produced: In 1976, 70%; 1980, 70%; 1990, 73%; 2000, 74%; 2020, 75%; 2040, 76%. These yield rates take into consideration the trend towards increased utilization of the continous casting process, and other technological advances as discussed in the text. Raw steel production by furnace type was then estimated by RRNA, based on knowledge of specific plants and trends in steelmaking obtained form interviews with industry and government officials.

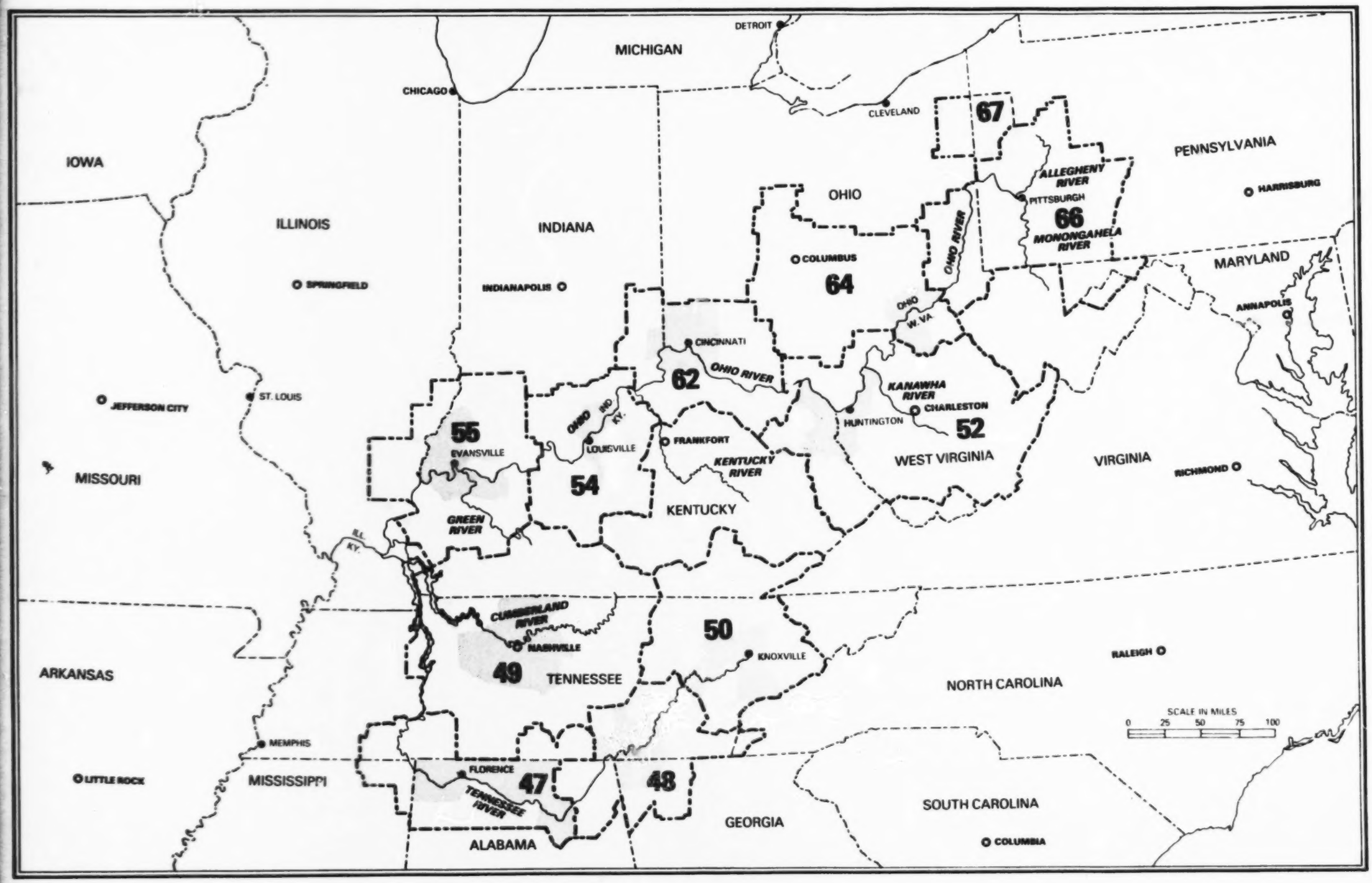
a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Steel production by BEA segment, 1976-2040, from Table A-19. Raw steel production by BEA segments 1969-76 from Table 12. Yield rates and trends in production by furnance from interviews with industry and government officials.

VI. APPENDIX B

BEST DOCUMENT AVAILABLE

MAP B-1. OHIO RIVER BASIN: PRIMARY STUDY AREAS FOR IRON ORE, STEEL, AND IRON (BEAs AND BEA SEGMENTS)



Primary Study Areas

SOURCE: Robert R. Nathan Associates, Inc.

BEST DOCUMENT AVAILABLE

Table B-1. Ohio River Basin: Primary Study Areas for Iron Ore, Steel and Iron

(BEAs and BEA segments)

BEA 47 (segment): Huntsville, AL
- Colbert, AL
- Lauderdale, AL
- Limestone, AL
- Madison, AL
- Marshall, AL

BEA 48 (segment): Chattanooga, TN
- Catoosa, GA
- Dade, GA
- Walker, GA
- Hamilton, TN
- Marion, TN
- Sequatchie, TN

BEA 49 (segment): Nashville, TN
- Cheatham, TN
- Davidson, TN
- Dickson, TN
- Robertson, TN
- Rutherford, TN
- Sumner, TN
- Williamson, TN
- wilson, TN

BEA 50 (segment): Knoxville, TN
- Anderson, TN
- Blount, TN
- Knox, TN
- Roane, TN
- Union, TN

BEA 52 (segment): Huntington, WV
- Boyd, KY
- Greenup, KY
- Lawrence, OH
- Cabell, WV
- Wayne, WV

BEA 54 (segment): Louisville, KY
- Clark, IN
- Floyd, IN
- Bullitt, KY
- Jefferson, KY
- Oldham, KY
- Clark, KY
- Floyd, IN

BEA 55 (segment): Evansville, IN
- Gibson, IN
- Posey, IN
- Vanderburgh, IN
- Warrak, IN
- Daviess, KY
- Henderson, KY

BEA 62 (segment): Cincinnati, OH
- Dearborn, IN
- Boone, KY
- Campbell, KY
- Kenton, KY
- Butler, OH
- Clermont, OH
- Hamilton, OH
- Warren, OH

BEA 64 (segment): Columbus, OH
- Wirt, WV
- Wood, WV
- Washington, OH

BEA 66 (segment): Pittsburgh, PA
- Belmont, OH
- Jefferson, OH
- Allegheny, PA
- Beaver, PA
- Butler, PA
- Cambria, PA
- Washington, PA
- Westmoreland, PA
- Brooke, WV
- Hancock, WV
- Marshall, WV
- Ohio, WV

BEA 67 (segment): Youngstown, OH
- Mahoning, OH
- Trumbull, OH
- Lawrence, PA
- Mercer, PA

Source: Robert R. Nathan Associates, Inc.

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